U.S. Army Center for Health Promotion and Preventive Medicine

USACHPPM

TRAINING MUNITIONS HEALTH RISK ASSESSMENT
NO. 39-EJ-1485-00
RESIDENTIAL EXPOSURE FROM INHALATION OF AIR EMISSIONS FROM THE LONG RIFLE .22 CALIBER BALL CARTRIDGE
DEPARTMENT OF DEFENSE IDENTIFICATION CODE: A106

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Readiness Thru Health

U.S. Army Center for Health Promotion and Preventive Medicine

The lineage of the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) can be traced back over 50 years. This organization began as the U.S. Army Industrial Hygiene Laboratory, established during the industrial buildup for World War II, under the direct supervision of the Army Surgeon General. Its original location was at the Johns Hopkins School of Hygiene and Public Health. Its mission was to conduct occupational health surveys and investigations within the Department of Defense's (DOD's) industrial production base. It was staffed with three personnel and had a limited annual operating budget of three thousand dollars.

Most recently, it became internationally known as the U.S. Army Environmental Hygiene Agency (AEHA). Its mission expanded to support worldwide preventive medicine programs of the Army, DOD, and other Federal agencies as directed by the Army Medical Command or the Office of The Surgeon General, through consultations, support services, investigations, on-site visits, and training.

On 1 August 1994, AEHA was redesignated the U.S. Army Center for Health Promotion and Preventive Medicine with a provisional status and a commanding general officer. On 1 October 1995, the nonprovisional status was approved with a mission of providing preventive medicine and health promotion leadership, direction, and services for America's Army.

The organization's quest has always been one of excellence and the provision of quality service. Today, its goal is to be an established world-class center of excellence for achieving and maintaining a fit, healthy, and ready force. To achieve that end, the CHPPM holds firmly to its values which are steeped in rich military heritage:

★ *Integrity is the foundation*
★ *Excellence is the standard*
★ *Customer satisfaction is the focus*
★ *Its people are the most valued resource*
★ *Continuous quality improvement is the pathway*

This organization stands on the threshold of even greater challenges and responsibilities. It has been reorganized and reengineered to support the Army of the future. The CHPPM now has three direct support activities located in Fort Meade, Maryland; Fort McPherson, Georgia; and Fitzsimons Army Medical Center, Aurora, Colorado; to provide responsive regional health promotion and preventive medicine support across the U.S. There are also two CHPPM overseas commands in Landstuhl, Germany and Camp Zama, Japan who contribute to the success of CHPPM's increasing global mission. As CHPPM moves into the 21st Century, new programs relating to fitness, health promotion, wellness, and disease surveillance are being added. As always, CHPPM stands firm in its commitment to Army readiness. It is an organization proud of its fine history, yet equally excited about its challenging future.

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TRAINING MUNITIONS HEALTH RISK ASSESSMENT NO. 39-EJ-1485-00 RESIDENTIAL EXPOSURE FROM INHALATION OF AIR EMISSIONS FROM THE LONG RIFLE .22 CALIBER BALL CARTRIDGE

EXECUTIVE SUMMARY

This assessment evaluated the potential for human health effects to offsite residents breathing air emissions following use of the Long Rifle .22 Caliber Ball Cartridge (.22 Caliber Ball) during training exercises.

To conduct this assessment, air emissions from the .22 Caliber Ball were collected in a test chamber at the U.S. Army Aberdeen Test Center, Maryland. The data collected from the Firing Point Emission Study provided the amount and types of substances released from the .22 Caliber Ball. This information was then used in an air dispersion model to determine ambient air concentrations at a location 100 meters (328 feet) downwind from a site where the .22 Caliber Ball may be used. Since the training facility in this assessment is hypothetical, the air model used assumptions that provided conservative estimates of air concentrations.

Modeled air concentrations were combined with exposure information (e.g., number of cartridges used per year) to estimate the amount of each substance the hypothetical offsite resident breathes. This estimate was then compared with the substance's health based screening level, which was obtained from agencies such as the U.S. Environmental Protection Agency, to determine if there is a potential for health effects from inhalation of these substances.

The health risk assessment included both long-term (30 years) and short-term (15-minute or 1-hour) exposures to modeled substance concentrations. Assessment results, generated using conservative methods, showed that the hypothetical offsite resident breathing air as close as 100 meters from the .22 Caliber Ball firing location is safe from these emissions. It should be noted that at most training installations, training areas are over 1,000 meters (over half a mile) away from populated areas.

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14. ABSTRACT
This assessment evaluated the potential for human health effects to offsite residents breathing air emissions following use of the Long Rifle .22 Caliber Ball cartridge. This document present the evaluation of the potential for adverse human health effects to the offsite residents breathing air emissions following the use of military firing ranges during training exercises. Study results showed no potential for health risks to the hypothetical resident from inhalation of air emissions from the .22 Caliber Cartridge. To conduct this study, air emissions from the .22 Caliber Ball Cartridge were collected in a test chamber (at Aberdeen Test Center, Aberdeen, MD). This information was then used in an air dispersion model to determine ambient air concentrations at a location downwind from the site where the item was activated. Modeled air concentrations were combined with exposure information to estimate the amount of substances the hypothetical resident breathes. This intake was combined with the substance's health information, to determine if there is a potential for health risks from inhjalation of these substances. The health risk included both long-term and short term exposures to the modeled substance concentrations. Study results showed no potential for helath risks from inhalation of air emissions from the .22 Caliber Ball Cartridge

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LIST OF ACRONYMS

AEC	U.S. Army Environmental Center
AEGL	Acute Exposure Guideline Levels
AIHA	American Industrial Hygiene Association
ATC	U.S. Army Aberdeen Test Center
ATV	Acute Toxicity Value
DOE	U.S. Department of Energy
DODIC	Department of Defense Identification Code
EPA	U.S. Environmental Protection Agency
ERPG	Emergency Response Planning Guidelines
HBSL	Health-Based Screening Level
INPUFF	Integrated PUFF Model
NAAQS	National Ambient Air Quality Standards
NEW	Net Explosive Weight
OEL	Occupational Exposure Limit
PM_{10}	Particulate Matter under 10 microns in size
PRG	Preliminary Remediation Goals
RBC	Risk-Based Concentration
RfC	Reference Concentration
TEEL	Temporary Emergency Exposure Limits
TPH	Total Petroleum Hydrocarbons
TSP	Total Suspended Particulates
USACHPPM	U.S. Army Center for Health Promotion and Preventive Medicine

TRAINING MUNITIONS HEALTH RISK ASSESSMENT NO. 39-EJ-1485-00 RESIDENTIAL EXPOSURE FROM INHALATION OF AIR EMISSIONS FROM THE LONG RIFLE .22 CALIBER BALL CARTRIDGE

1. PURPOSE

This document presents the assessment of the potential for human health effects to offsite residents breathing air emissions following use of the Long Rifle .22 Caliber Ball Cartridge (.22 Caliber Ball) on firing ranges during training exercises.

2. AUTHORITY

Statement of Work, 30 November 2000, Training Munitions Inhalation Health Risk Evaluations.

3. REFERENCES

See Appendix A for a list of references.

4. BACKGROUND

4.1 CARTRIDGES AND THEIR USE

Cartridges are cases that contain a primer, propelling charge, and projectile. The primer is needed to activate the propelling charge, which provides the force to send the projectile to a target. Examples of projectiles include bullets, rockets, and missiles. Cartridges are also referred to as "rounds" and are fired from weapons such as pistols or rifles. The use of cartridges with weapons during training activities is important in preparing our soldiers for a variety of combat situations.

4.2 WHAT IS THE LONG RIFLE .22 CALIBER BALL CARTRIDGE?

The .22 Caliber Ball is a type of ball ammunition used for marksmanship practice and match use. The .22 Caliber Ball consists of a copper alloy cartridge case and a lead-antimony bullet. It also contains a propelling charge that consists mostly of nitrocellulose. Nitrocellulose is the primary ingredient in smokeless propellant (for both military and commercial use) and is also used in the production of lacquers and artificial leathers. Each .22 Caliber Ball cartridge is about as long as the width of a quarter (Reference 1).

4.3 ASSESSMENT SUMMARY

The .22 Caliber Ball was evaluated using an approach consisting of two main parts: air dispersion modeling and exposure assessment, which are briefly discussed in the paragraphs below. Sections 5 through 7 present a discussion of the methodology used for this assessment.

Emissions data used in the air dispersion modeling were obtained from the Firing Point Emission Study, conducted by the U.S. Army Aberdeen Test Center (ATC), at Aberdeen Proving Ground, Maryland (Reference 2). This study was funded by the U.S. Army Environmental Center (AEC) with the purpose of identifying and quantifying emissions from weapons firing. Data from this study were generated by firing munitions in a test chamber using weapons that are representative of those used by the U.S. Army during training. Emissions data for the .22 Caliber Ball were generated by firing it from either the Armalite® AR-7 Explorer Rifle or an M16 rifle fitted with a caliber .22 Ball, Long Rifle conversion kit.

The emissions data for the .22 Caliber Ball were used with an atmospheric dispersion model to estimate the average concentrations that may be experienced by an offsite resident. Since this assessment is designed to provide results that would be applicable to most Army training facilities, the training area used in this assessment was a hypothetical one. While most training areas are at least 1,000 meters away from populated areas, as a conservative distance, it was initially assumed that a person could reside 100 meters downwind from the firing point (location where the rifle is positioned). In addition, air-modeling parameters were selected to mimic worst-case conditions.

The exposure assessment included calculations of time-averaged concentrations for both long-term (chronic) and short-term (acute) exposures. For the purpose of this assessment, air concentrations were averaged over 30 years for chronic exposures and 1-hour or 15 minutes for acute exposures. Using a screening approach, a substance's estimated time-averaged air concentration was then compared to a chronic health-based screening level (HBSL) selected from sources established by the U.S. Environmental Protection Agency (EPA) and an acute toxicity value (ATV) selected from levels established by selected agencies depending on the exposure duration (i.e., 30 years versus 1-hour or 15 minutes). The terms HBSL and ATV are used for the purposes of this assessment. The comparison was made using the ratio of the HBSL or ATV to the estimated air concentration for each of the substances evaluated. If this ratio was less than one, no further evaluation was needed. This approach is conservative because the exposure assumptions used by the agencies, to establish HBSLs and ATVs, are likely to overestimate the exposures experienced by offsite residents living near firing ranges. If the chronic or acute averaged concentrations ($C_{chronic}$ and C_{acute}) were greater than these screening levels, further analysis would be warranted to determine the potential for health effects. Note that concentrations greater than the screening levels do not indicate an onset of health effects, but rather the potential for such.

5. DATA COLLECTION AND AIR MODELING

5.1 EMISSION FACTORS

Emission factors, used to derive the air modeling emission rates used in this assessment, were generated from the Firing Point Emission Study conducted by the ATC (Reference 2). This study identified and quantified air emissions from the firing of

training munitions. The data included the net explosive weight (NEW), the substances sampled, and substance-specific emission factors. Emissions data from the Firing Point Emission Study are included in the first five columns of the table located in Appendix B.

5.2 BACKGROUND AND DESCRIPTION

Air dispersion models are available to mathematically simulate plume behavior and to estimate downwind concentrations of substances emitted from various sources. However, specific models are not available to determine the dispersion of emissions from munitions used during training. Estimating the magnitude and location of these concentrations depends on many factors including the amount and type of emissions, the behavior of the source, and meteorological conditions. Since a specific model is not available for modeling the use of munitions during training, the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) evaluated numerous air models to determine which would be suitable for use with munitions used during training. The USACHPPM recommended using the Integrated PUFF (INPUFF) model to estimate the dispersion of emissions from various munitions sources (Reference 3).

The INPUFF Model (Reference 4) was developed to simulate dispersion from instantaneous or semi-continuous point sources. This Gaussian-integrated puff model is capable of addressing a cloud type release over short periods of time, and computations can be performed for a single point source for multiple receptors. The algorithms used to calculate concentrations assume a vertically uniform wind direction (with no chemical reaction) to compute the contribution of each cloud at a receptor for each time step/interval.

5.3 MODEL ASSUMPTIONS

Some assumptions were made to best represent the firing of the .22 Caliber Ball cartridges. These assumptions were as follows:

- Typically, with conventional point sources (such as incinerators), the cloud rise and formation are determined by characterizing flue gas exit velocity, temperature, and stack diameter. However, the .22 Caliber Ball cartridges are used in conjunction with rifles. For unconventional sources with no real physical stack dimensions, such as rifles, the stack height and diameter were assumed to equal the height of the barrel and the bore diameter, respectively. No exit velocity was used with this source because the emission rates generated from the test data were obtained from sampling a stabilized cloud with no exit velocity. Table 1 includes the source parameters used to model the .22 Caliber Ball cartridges.

TABLE 1: SOURCE PARAMETERS

Parameter	Model Input
Source/Stack Diameter	0.009 meters
Source/Stack Height	1 meter
Source Exit Temperature	298.15 degrees Kelvin (°K) (or 77 °F)
Exit Velocity	0 meters/second
Initial horizontal dispersion coefficient (σ_y)	0.87 meters
Initial vertical dispersion coefficient (σ_z)	1.07 meters

- Initial cloud dimensions are preferred to model the air emissions from these types of releases. Typically, these dimensions are used to define the initial horizontal and vertical dispersion values (σ_y and σ_z) of the released cloud. However, this information was not measured during the studies at the ATC; therefore, the cloud dimensions were based on the test chamber dimensions and the volume of air sampled. By assuming an elliptical cloud with the prevailing wind direction being perpendicular to the rifle when fired, the test chamber's radius would be equal to the initial vertical dispersion (σ_z), and the initial horizontal dispersion (σ_y), would be equal to one half the length of the test chamber. The cloud exit temperature was assumed to be equal to the test chamber temperature.

- For the purposes of this assessment, a hypothetical offsite resident was assumed to be located 100 meters directly downwind from the source. The meander of the cloud is a major factor when estimating concentrations at given locations downwind from the source. Assuming that the resident is directly downwind from the source is the same as assuming that there is no cloud meander and the center of the cloud migrates directly over the hypothetical offsite resident. This assumption provides the most conservative modeled concentrations.

- Since this assessment does not look at a specific training site, generic, worst-case meteorological data were used. To determine the worst-case meteorological conditions that would result in the highest air emission concentrations, the modeling was performed using the EPA Risk Management Program Guidance (Reference 5). This guidance includes tables for estimating the footprint of chemical releases and is intended to inform emergency responders of potential accidental releases. The EPA has defined most default conditions for meteorological modeling parameters. Table 2 lists the meteorological parameters that were used in the air model.

TABLE 2: WORST-CASE METEOROLOGICAL PARAMETERS

Parameter	Input Value
Wind Speed	1 meter/second
Atmospheric Stability	Category F
Wind Direction	270°
Ambient Temperature	293 degrees Kelvin (°K) (or 68 °F)

5.4 GENERAL METHODOLOGY

The model was run for a total calculation time of 200 seconds to ensure that the total mass of the cloud had passed the hypothetical resident location. Concentrations were calculated every 2 seconds. The model results indicated that the initial cloud reached the hypothetical offsite resident within 80 seconds and dissipated below the lowest concentration the model calculated, which in this instance (1×10^{-11} g/m^3) occurred within 138 seconds. Table 3 contains the air model input parameters used in this assessment.

TABLE 3: AIR MODEL INPUT PARAMETERS

Parameter	Input Value
Number of meteorological periods (NTIME)	1
Duration of each meteorological period (ITIME)	200 seconds
Number of updates to the source (NSRCDS)	100
Duration/time step between each source update (ISUPDT)	2 seconds
Total time modeled/Simulation Period (NTIME) (ITIME)= (NSRCDS) (ISUPDT)	200 seconds

5.5 USE OF MODEL OUTPUT

The concentrations provided by the INPUFF model were based on a unit emission rate (ER_{unit}) of 1 gram/second from an emission source, and did not represent any substance-specific concentrations from the use of any weapons system. This unit emission rate is typically used for ease of modeling purposes. The relationship between the emission rate and predicted concentration is linear. Therefore, the ratio of the predicted concentration to the unit emission rate was multiplied by each substance-specific emission rate to provide substance-specific concentrations.

5.6 DETERMINATION OF SUBSTANCE-SPECIFIC EMISSION RATES

The actual substance emission rate for one item (ER_1) for each substance was calculated using Equation 1. Example 1 contains a sample calculation using this equation.

$$ER_1 = \frac{EF \cdot CV}{t} \qquad \text{Equation 1}$$

Where:

ER_1 = emission rate for one item (g/item)/sec
EF = average adjusted emission factor (lb/item)
CV = conversion factor (453.59 g/lb)
t = release duration obtained from the INPUFF model (sec)

Example 1
Sample Calculation Using Equation 1:

$$\mathrm{ER}_1 = \frac{(5.90\mathrm{E}-08)\,(453.59)}{(2)}$$

= 1.339E-05 g/sec/item

Calculation provided for benzene. Appendix B provides the average adjusted emission factor (EF) in lb/item.

Substance-specific ambient concentrations for one item (CONC) were calculated using Equation 2. A sample calculation using this equation is provided in Example 2. Appendix B contains the estimated air concentrations.

$$CONC = ER_1 \cdot \frac{UC}{ER_{unit}} \qquad \text{Equation 2}$$

Where:

CONC = substance concentration based on one item (g/m^3)
ER_1 = emission rate for one item (g/sec)
ER_{unit} = unit emission rate as used in the model (g/sec)
UC = concentration based on the unit emission rate (g/m^3)

Example 2
Sample Calculation Using Equation 2:

$$CONC = (1.339E-05)\frac{(2.061E-04)}{(1)}$$

$= 2.760$ E-09 g/m^3

Calculation provided for benzene.

6. RISK ASSESSMENT

6.1 EXPOSURE ASSUMPTIONS

Exposure assumptions were selected using a typical use scenario for the .22 Caliber Ball. The typical use scenario was provided by the AEC and is based on consultation with their senior training advisor (References 6, 7). The frequency of use for the .22 Caliber Ball was required to determine how much substance an offsite resident would be exposed to in the time period of interest (i.e., acute or chronic exposure). Table 4 summarizes the general use scenario for the .22 Caliber Ball.

TABLE 4: FREQUENCY OF USE FOR THE LONG RIFLE .22 CALIBER BALL CARTRIDGE

Parameter	Value Used
Number of cartridges used per year	6,550
Maximum number of cartridges used in 1-hour	200

6.2 TIME-AVERAGING

For the chronic assessment, time-averaged concentrations were calculated by assuming that the hypothetical offsite resident would be exposed for 30 years. This is consistent with the exposure duration used by the EPA, which assumes that the resident spends 30 years at the same residence. By using the same exposure duration, the estimated time-averaged concentrations could be compared with their respective HBSLs, which are derived using standard EPA default assumptions.

Using the default residence time established by the EPA, the assumption was made that someone could be exposed to air emissions from 6,550 cartridges per year for 30 years. Table 5 lists the exposure parameters used to estimate concentrations for the chronic assessment. These parameters are based on the typical use scenario provided by AEC (Table 4) and the assumptions used in the air model run.

TABLE 5: EXPOSURE PARAMETERS USED TO DETERMINE TIME-AVERAGED CHRONIC AIR CONCENTRATIONS

Exposure Parameter	Value Used
Exposure Time (ET_{ctg})	3.333 min/cartridge[1]
Exposure Frequency (EF_{ctg})	6,550 cartridges/year
Exposure Duration (ED)	30 years[2]

[1]Based on the total model time of 200 seconds (3.33 minutes) used in the air model run.
[2]EPA default value.

Chronic averaged concentrations were calculated using Equation 4. Example 4 shows how this calculation was performed. Since benzene is classified as a carcinogen, as indicated in Appendix C, the averaging time (AT) is 70 years.

$$C_{chronic} = \frac{CONC \cdot 10^6 \cdot ET_{ctg} \cdot EF_{ctg} \cdot ED}{525{,}600 \cdot AT} \qquad \text{Equation 4}$$

Where:

$C_{chronic}$ = average chronic concentration (μg/m^3)
CONC = average modeled concentration for one cartridge (g/m^3)
10^6 = unit conversion (μg/g)
ET_{ctg} = exposure time per cartridge (minutes/cartridge)
EF_{ctg} = exposure frequency (cartridges/year)
ED = exposure duration (years)
525,600 = unit conversion (minutes/year)
AT = averaging time (years)
(Carcinogenic endpoint: AT = 70 years
Noncarcinogenic endpoint: AT = ED)

Example 4
Sample Calculation Using Equation 4:

$$C_{chronic(benzene)} = \frac{(2.760\text{E-}09)(10^6)(3.333)(6{,}550)(30)}{(525{,}600)(70)}$$

= 4.91E-05 μg/m^3

The average modeled concentration for one cartridge (CONC) was obtained from Appendix B. The exposure parameters were obtained from Table 5.

Since many cartridges may be fired in a short period of time, acute exposures cannot be overlooked. Unlike the chronic assessment, only limited guidance for evaluating acute exposures is currently available. For the purpose of this assessment, acute exposure is defined as a 1-hour or 15-minute exposure. The 1-hour or 15-minute acute exposure averaging times allow for comparison with guidelines developed specifically for emergency planning purposes (see discussion on acute toxicity below).

The exposure frequency is based on the number of cartridges used per 1-hour or 15 minutes depending on the guideline used for comparison. This information is based on the use scenario provided by the AEC (Table 4). To estimate air concentrations for potential acute health impacts, it was conservatively assumed that 200 .22 Caliber Ball cartridges are fired in 1-hour. The average acute concentrations were computed using Equation 5. Example 5 contains a sample calculation using this equation. Benzene is used as the example substance.

$$C_{acute} = \frac{CONC \cdot 10^6 \cdot ET_{ctg} \cdot EF_{ctg}}{60} \qquad \text{Equation 5}$$

Where:

C_{acute} = average acute concentration (μg/m^3)
CONC = average modeled concentration for one cartridge (g/m^3)
10^6 = unit conversion (μg/g)
ET_{ctg} = exposure time per cartridge (minutes/cartridge)
EF_{ctg} = exposure frequency (cartridges/hour)*
60 = unit conversion (minutes/hour)

* Based on 1-hour or 15 minute (0.25 hour) ATV

Example 5
Sample Calculation Using Equation 5:

$$C_{acute(benzene)} = \frac{(2.760E-09)(10^6)(3.333)(200)}{60}$$

= 3.07E-02 μg/m^3

The average modeled concentration for one cartridge (CONC) for benzene was obtained from Appendix B. See Appendix C to determine the ATV used.

6.3 TOXICITY ASSESSMENT

The potential for health effects was determined by comparing time-averaged air concentrations to health-based screening levels, which are developed from a substance's known toxicity. These toxicity values typically include different levels of safety factors depending on the level of confidence of the critical study. Appendix C contains a table of screening levels used for the chronic and acute assessments.

6.3.1 CHRONIC ASSESSMENT

The chronic assessment was conducted using a screening approach. Using this method, a substance's estimated time-averaged air concentration was compared to its HBSL. If this ratio was less than one, no further analysis was needed. This approach is conservative because the exposure assumptions used by the EPA, to establish HBSLs, assume that the resident is exposed for 350 days per year (assuming 2 weeks vacation per year). In contrast, exposure to air emissions from actual training activities at a firing range is intermittent and is not likely to occur on a daily basis year round.

A hierarchy of sources was developed for selection of the HBSLs to quantitatively evaluate as many of the identified substances as possible. The hierarchy of sources used was as follows:

- Clean Air Act, EPA National Ambient Air Quality Standards (NAAQS) (Reference 8)
- EPA Region 9 Preliminary Remediation Goals (PRGs) (Reference 9)
- EPA Region 3 Risk-Based Concentrations (RBCs) (Reference 10)

Some substances have neither PRGs nor RBCs because they have their own set of regulatory standards. Under the Clean Air Act, the EPA is required to establish NAAQS for several substances considered harmful to public health and the environment. Currently, NAAQS are available for seven substances. The NAAQS for the longer averaging time were used for the chronic assessment. Depending on the substance, this can range from an 8-hour average to an annual average. In addition, since the majority of the measured total suspended particulates (TSP) were PM_{10} (particulate matter under 10 microns in size) (Reference 2), the NAAQS for PM_{10} was used to evaluate the potential for health effects from exposure to TSP.

Next on the hierarchy, after the NAAQS, are the EPA Region 9 PRGs and the EPA Region 3 RBCs. The methodology used by EPA Region 9 to develop the PRGs generally results in lower values than the EPA Region 3 RBCs. However there were occasions when the RBCs were lower than the PRGs. To maintain a conservative approach for this assessment, the lower of the two values from these sources was selected as the HBSL for each substance evaluated. If only one value was available from these sources it was selected as the HBSL. To ensure that the most recent information was used, the Internet sites of both EPA Regions were checked. Appendix C presents the HBSLs used for this assessment.

Although the general approach used by both EPA Region 3 and Region 9 is the same, the exposure assumptions differ enough so that final recommended values can vary to a certain degree. In both methods, a substance's screening concentration was selected using the toxicity endpoint that derives a lower concentration. For example, if a substance has a known systemic toxicity and is a carcinogen, the screening concentration was calculated using both toxicity values. To maintain a conservative approach, EPA then selected the lower screening concentration as the recommended PRG or RBC.

Example 6 shows a sample calculation of how a substance's estimated chronic concentration was compared to its HBSL using benzene concentration.

Example 6
Sample Calculation Comparing a Substance's Estimated Chronic Concentration to Its HBSL:

$$\frac{C_{chronic(benzene)}}{HBSL} = \frac{4.91\text{E-}05}{2.16E-01}$$

$$= 2.27\text{E-}04 < 1$$

In this case, the resulting ratio is less than one, indicating further evaluation is not necessary.

Many petroleum hydrocarbons were detected but do not have specific screening levels. Therefore, the approach recommended by the Total Petroleum Hydrocarbon Criteria Working Group (Reference 11) was adopted to evaluate petroleum hydrocarbon mixtures. Based on the working group's assessment of various hydrocarbons, it was recommended that mixtures be separated according to a substance's number of carbons and its chemical class (i.e., aliphatic or aromatic[1]). Generally, as a substance's carbon number increases, its molecular weight increases, and it is, therefore, not a substance of concern via inhalation. The working group also concluded that aromatic hydrocarbons tend to be more toxic than aliphatic hydrocarbons (Reference 11). Table 6 tabulates the inhalation toxicity values used to evaluate exposure to petroleum mixtures. To be consistent with the methodology used in this assessment, the reference concentrations (RfCs) were converted to PRGs using Region 9 exposure assumptions. The resulting PRGs were used as the HBSLs for the petroleum hydrocarbons in this assessment. Appendix D presents these values.

[1] Aliphatic hydrocarbons are hydrocarbons in which the carbon atoms are joined by single covalent bonds consisting of two shared electrons (e.g., butane). Aromatic hydrocarbons have ring structures (e.g., benzene) (Reference 12).

TABLE 6: SUMMARY OF RfCs USED FOR PETROLEUM HYDROCARBONS[1]

Carbon Range	Aromatic Inhalation RfC (mg/m^3)	Aliphatic Inhalation RfC (mg/m^3)
$C_5 - C_6$ $C_{>6} - C_8$		18.4
$C_{>7} - C_8$	0.4	
$C_{>8} - C_{10}$ $C_{>10} - C_{12}$ $C_{>12} - C_{16}$	0.2	1.0
$C_{>16} - C_{21}$ $C_{>21} - C_{35}$	NA	NA

[1]Reference 11
NA = not applicable for high molecular weight total petroleum hydrocarbons ($C_{>16}$) because substances in this carbon range are not volatile and therefore, inhalation is not a pathway of concern.

6.3.2 ACUTE ASSESSMENT

An established method for assessing acute health effects is not currently available. In 1995 the EPA recognized the need for acute exposure guidelines for emergency response purposes and created the National Advisory Committee for Acute Exposure Guideline Levels (AEGLs) for Hazardous Substances. Currently, AEGLs are available for only a few substances.

To overcome the unavailability of acute toxicity data, several state regulatory agencies have suggested that guidelines developed for emergency purposes be used in the interim. Although suggestions have been made to use occupational exposure limits (OELs) by applying additional safety factors (References 13, 14), OELs were not used in this assessment because they introduce even more uncertainty than the use of emergency guidelines. The OELs are designed to protect the workplace environment and assume 8 hours a day, 5 days a week exposures. By definition, these exposures are more chronic than acute. In comparison, emergency planning guidelines are more appropriate because they are typically developed for exposures of 1-hour or less. In addition, safety factors are included as part of the guideline development so that the values would be protective of the general population.

For this study, the hierarchy of sources for ATV selection was as follows with each ATV defined below:

- EPA AEGL-1. "AEGL-1 is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic, nonsensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure."

- AIHA ERPG-1. "The maximum concentration in air below which it is believed nearly all individuals could be exposed for up to 1- hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor."

- DOE TEEL-1. "The maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor."

Emergency Response Planning Guidelines (ERPGs) published by the American Industrial Hygiene Association (AIHA) (Reference 15) and the Temporary Emergency Exposure Limits (TEELs) developed by the U.S. Department of Energy (DOE) (Reference 16) were used for this assessment, specifically the ERPG-1s and the TEEL-1s. Since TEEL-1s are intended for exposures up to 15-minutes, air concentrations compared to TEELs were averaged over a 15-minute period. Air concentrations compared to ERPGs and AEGLs were averaged over 1-hour, as these values are intended for 1-hour exposures.

AEGLs were used first when available since they are developed specifically for the purpose of acute exposure assessments. The ERPGs were selected next, prior to a substance's TEEL, because they are vigorously reviewed before they are published, whereas the TEELs are not.

Example 7 shows a sample calculation of how a substance's estimated acute concentration was compared to its ATV.

Example 7
Sample Calculation of Comparing a Substance's Estimated Acute Concentration to Its Acute Toxicity Value:

$$\frac{C_{acute(benzene)}}{ATV} = \frac{3.07\text{E} - 02}{1.56E + 05}$$

$$= 1.97\text{E-}07 < 1$$

In this example with benzene, the ratio is less than one, indicating that further analysis is not necessary.

7. RISK CHARACTERIZATION

As previously described, the exposure assessment included calculations of time-averaged concentrations for both long-term (chronic) and short-term (acute) exposures. Using a screening approach, a substance's estimated time-averaged air concentration was then compared to chronic HBSLs or ATVs. The comparison was made using the ratio of the HBSL or ATV to the estimated concentration. This approach is conservative because the exposure assumptions used by the EPA and other agencies, to establish HBSLs and ATVs, are likely to overestimate the exposures experienced by offsite residents living near firing ranges.

If this ratio was less than one, no further evaluation was needed. If the chronic or acute averaged concentrations ($C_{chronic}$ and C_{acute}) were greater than the screening levels, resulting in a ratio greater than one, further evaluation would be warranted to determine the potential for health effects. Note that concentrations greater than the screening levels do not indicate an onset of health effects, but rather, the potential for such.

The chronic and acute assessments were conducted as outlined in Section 6.3. Appendix D presents results from the .22 Caliber Ball risk characterization.

7.1 CHRONIC HEALTH RISK

The outcome of the chronic assessment indicated that no chronic health effects are expected from breathing the air emissions from the .22 Caliber Ball. Since the ratios for all substances were below one, further evaluation was not needed.

7.2 ACUTE HEALTH RISK

For the acute assessment, all ratios were below one, indicating that no acute health effects are expected from breathing the air emissions from the .22 Caliber Ball. The ratios for all substances were less than one, indicating further evaluation was not necessary.

7.3 FACT SHEET

Appendix E includes a copy of the fact sheet submitted to the AEC. The fact sheet uses the results from this assessment to communicate information related to inhalation of .22 Caliber Ball air emissions.

8. UNCERTAINTY DISCUSSION

The limitations inherent in modeling and the added conservatism of the assessment contribute to the uncertainty of the assessment results. The risk assessment methodology typically includes safety factors that are embedded in the toxicity data to ensure adequate protection of the general population, particularly, susceptible individuals such as the sick, elderly, and children. Table 7 identifies areas of uncertainty associated with this assessment.

TABLE 7: TYPES OF UNCERTAINTY

Issue	Uncertainty	Direction of Effect
Modeling		
Modeled versus real-time sampling	The air concentrations in this assessment were modeled. Actual air concentrations taken from the field may be higher or lower.	Varies
Frequency of use for the .22 Caliber Ball	Actual frequency of use for these munitions during training exercises may be different from those stated in this report.	Varies
Hypothetical offsite resident assumed to be located directly downwind	Unless the area around the training facility is populated, the chances that a person living directly downwind is low.	Overestimates
Use of worst-case meteorological conditions	To ensure that this assessment is applicable to most training areas, worst-case meteorological conditions were used in the air model.	Overestimates
Exposure Assessment		
Estimating time-averaged concentrations	Actual exposure from the .22 Caliber Ball is intermittent. If one were to plot a person's exposure profile, the plot would consist of a series of spikes. Since current risk assessment methodology does not allow the evaluation of the potential for health risks as a function of time, a single concentration, averaged over the exposure duration was used. In this assessment, the exposure durations used were 30 years and 1-hour or 15 minutes.	Varies
Comparing estimated concentration to established screening levels	The Region 3 and Region 9 HBSLs were developed using different exposure assumptions than those in this assessment, resulting in more conservative screening levels.	Overestimates
Comparing estimated concentrations to established screening levels	Comparison to screening levels does not account for possible cumulative effects of exposure to more than one substance.	Underestimates

TABLE 7: TYPES OF UNCERTAINTY

Issue	Uncertainty	Direction of Effect
Screening assessment versus calculating an average daily intake	Calculating an average daily intake allows the use of scenario-specific assumptions. However, unless the ratio of concentration to screening level approaches one, a screening assessment is useful as a first-cut evaluation.	Varies
Exposure to other munitions	Other munitions are typically used during the same training exercise. These items may contain similar or different substances from those detected in the .22 Caliber Ball.	Underestimates
Toxicity Assessment		
Lack of toxicity data	Some substances were not quantitatively evaluated because they have no known toxicity data.	Underestimates
Modifying and uncertainty factors for toxicity data	Modifying factors and uncertainty factors of varying degree are typically applied to toxicological values. These factors are used to conservatively account for extrapolating from animal studies for human health evaluation, and to conservatively account for variation in human populations.	Overestimates

9. CONCLUSION

Using conservative assumptions, the assessment indicated that offsite residents who live as close as 100 meters directly downwind from the firing location are safe from breathing air emissions from the .22 Caliber Ball. It is believed that the assumptions contained in this analysis are conservative enough to be protective of all the population including the sick, elderly, and children.

10. RECOMMENDATIONS

The results from this assessment are intended for a hypothetical training facility, and actual results may vary depending on site-specific conditions. This assessment used conservative assumptions (e.g., worst-case meteorological conditions, receptor located directly downwind, etc.) and it is believed that most site-specific analyses would result in even lower concentrations. Therefore, the results from this assessment should be applicable to most training facilities, unless site-specific conditions vary significantly.

10. POINT OF CONTACT

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APPENDIX A

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APPENDIX B

AIR DISPERSION MODELING OUTPUT DATA

Table B-1: Air Modeling Output Data for the Long Rifle .22 Caliber Ball Cartridge

	Cartridge, Caliber .22 Ball, Long Rifle					No. of rounds (I)	1	round
	Number of items: Trial #1B =>	71		Trial #2B =>	71	release duration (t):	2	seconds
		Net Explosive Weight - N.E.W. per item (lbs.) =>			3.57E-04	Unit Concentration (UC):	2.061E-04	$g/m^3/(g/s)$
	ATC Firing Test Results[1]							
Substance	Trial #1B Measured Actual Concentration (mg/m^3)	Trial #2B Measured Actual Concentration (mg/m^3)	Daily Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb./item) EF	Average Adjusted Emission Factor (lb./lb. NEW)	Total Mass of Substance Emitted (grams/item) M	Average Modeled Concentration for One Item ($grams/m^3$) CONC	Substance Emission Rate For One Item (g/item)/sec ER_1
Permanent Gases								
Ammonia (NH_3)	7.00E+00	7.00E+00	NA	ND	ND	ND	ND	ND
Carbon Dioxide (CO_2)	3.62E+02	3.49E+02	NA	7.38E-05	2.07E-01	3.347E-02	3.449E-06	1.674E-02
Carbon Monoxide (CO)	3.80E+02	3.81E+02	NA	7.89E-05	2.21E-01	3.579E-02	3.688E-06	1.789E-02
Oxides of Nitrogen (NO_x)	1.54E+01	1.56E+01	NA	3.22E-06	9.01E-03	1.459E-03	1.504E-07	7.296E-04
Sulfur Dioxide (SO_2)	5.24E-01	5.24E-01	NA	ND	ND	ND	ND	ND
Acid Gases								
Hydrogen Fluoride	2.30E-01	2.30E-01	2.50E-01	ND	ND	ND	ND	ND
Hydrogen Chloride	2.30E-01	2.20E-01	2.40E-01	ND	ND	ND	ND	ND
Hydrogen Bromide	2.20E-01	2.20E-01	2.40E-01	ND	ND	ND	ND	ND
Nitric Acid	2.30E-01	3.70E-01	2.40E-01	8.71E-08	2.44E-04	3.949E-05	4.069E-09	1.974E-05
Phosphoric Acid	2.30E-01	2.20E-01	2.40E-01	ND	ND	ND	ND	ND
Sulfuric Acid	2.30E-01	2.20E-01	2.40E-01	ND	ND	ND	ND	ND
Cyanide								
Particulate Cyanide	1.30E-02	1.30E-02	1.40E-02	ND	ND	ND	ND	ND
Hydrogen Cyanide	2.67E-01	4.11E-01	1.40E-02	8.15E-08	2.28E-04	3.696E-05	3.808E-09	1.848E-05
Particulate								
Total Suspended Particulate	1.27E+01	1.41E+01	NA	3.25E-06	9.08E-03	1.472E-03	1.517E-07	7.360E-04
Particulate Matter <10 microns	1.30E+01	1.43E+01	NA	3.30E-06	9.22E-03	1.495E-03	1.540E-07	7.473E-04
Particulate Matter <2.5 microns	9.92E+00	1.10E+01	NA	2.52E-06	7.06E-03	1.143E-03	1.178E-07	5.716E-04
Metals								
Aluminum	9.04E-02	1.74E-01	1.83E-01	ND	ND	ND	ND	ND
Antimony	3.50E-02	3.70E-02	1.17E-02	8.69E-09	2.43E-05	3.943E-06	4.063E-10	1.971E-06
Arsenic	1.15E-02	1.17E-02	1.17E-02	ND	ND	ND	ND	ND
Barium	1.15E-02	1.17E-02	1.17E-02	ND	ND	ND	ND	ND
Beryllium	1.15E-02	1.17E-02	1.17E-02	ND	ND	ND	ND	ND

Table B-1: Air Modeling Output Data for the Long Rifle .22 Caliber Ball Cartridge

Substance	Trial #1B Measured Actual Concentration (mg/m^3)	Trial #2B Measured Actual Concentration (mg/m^3)	Daily Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb./item) EF	Average Adjusted Emission Factor (lb./lb. NEW)	Total Mass of Substance Emitted (grams/item) M	Average Modeled Concentration for One Item ($grams/m^3$) CONC	Substance Emission Rate For One Item (g/item)/sec ER_1
Cadmium	1.15E-02	1.17E-02	1.17E-02	ND	ND	ND	ND	ND
Calcium	1.54E-01	2.71E-01	2.68E-01	ND	ND	ND	ND	ND
Chromium	1.15E-02	1.17E-02	1.17E-02	ND	ND	ND	ND	ND
Cobalt	1.15E-02	1.17E-02	1.17E-02	ND	ND	ND	ND	ND
Copper	2.61E-02	2.87E-02	1.17E-02	6.62E-09	1.85E-05	3.005E-06	3.096E-10	1.502E-06
Lead	7.20E+00	7.90E+00	1.17E-02	1.82E-06	5.10E-03	8.269E-04	8.521E-08	4.134E-04
Magnesium	3.21E-02	5.84E-02	1.63E-01	ND	ND	ND	ND	ND
Manganese	1.15E-02	1.17E-02	1.17E-02	ND	ND	ND	ND	ND
Nickel	1.15E-02	1.17E-02	1.17E-02	ND	ND	ND	ND	ND
Selenium	1.15E-02	1.17E-02	1.17E-02	ND	ND	ND	ND	ND
Silver	1.15E-02	1.17E-02	1.17E-02	ND	ND	ND	ND	ND
Thallium	1.15E-02	1.17E-02	1.17E-02	ND	ND	ND	ND	ND
Vanadium	1.15E-02	1.17E-02	1.17E-02	ND	ND	ND	ND	ND
Zinc	6.27E-02	6.39E-02	1.17E-02	1.53E-08	4.28E-05	6.939E-06	7.150E-10	3.469E-06
TO-11 Carbonyls								
Formaldehyde	5.30E-01	5.70E-01	2.20E-01	8.57E-08	2.40E-04	3.888E-05	4.007E-09	1.944E-05
Acetaldehyde	3.60E-01	3.50E-01	2.80E-01	2.59E-08	7.25E-05	1.176E-05	1.211E-09	5.878E-06
Acetone	1.00E+00	1.00E+00	1.00E+00	ND	ND	ND	ND	ND
Acrolein	2.00E-01	2.00E-01	2.00E-01	ND	ND	ND	ND	ND
Proprionaldehyde	2.00E-01	2.00E-01	2.00E-01	ND	ND	ND	ND	ND
Crotonaldehyde	2.00E-01	2.00E-01	2.00E-01	ND	ND	ND	ND	ND
Butyraldehyde	1.59E+00	1.43E+00	1.55E+00	3.38E-08	9.46E-05	1.532E-05	1.579E-09	7.661E-06
Benzaldehyde	2.00E-01	2.00E-01	2.00E-01	ND	ND	ND	ND	ND
Isovaleraldehyde	2.00E-01	2.00E-01	2.00E-01	ND	ND	ND	ND	ND
Valeraldehyde	2.00E-01	2.00E-01	2.00E-01	ND	ND	ND	ND	ND
o,m,p-Tolualdehyde	6.00E-01	6.00E-01	6.00E-01	ND	ND	ND	ND	ND
Hexaldehyde	2.00E-01	2.00E-01	2.00E-01	ND	ND	ND	ND	ND
2,5-Dimethylbenzaldehyde	2.00E-01	2.00E-01	2.00E-01	ND	ND	ND	ND	ND
TO-14 VOCs (extended list)								
Propene	2.93E-01	3.10E-01	8.61E-04	6.89E-08	1.93E-04	3.123E-05	3.218E-09	1.562E-05
Dichlorodiflouromethane	2.97E-03	2.97E-03	3.46E-03	ND	ND	ND	ND	ND
Chlorodifluoromethane	3.54E-03	3.54E-03	3.54E-03	ND	ND	ND	ND	ND
Freon 114	6.99E-03	6.99E-03	6.99E-03	ND	ND	ND	ND	ND

Table B-1: Air Modeling Output Data for the Long Rifle .22 Caliber Ball Cartridge

Substance	Trial #1B Measured Actual Concentration (mg/m^3)	Trial #2B Measured Actual Concentration (mg/m^3)	Daily Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb./item) EF	Average Adjusted Emission Factor (lb./lb. NEW)	Total Mass of Substance Emitted (grams/item) M	Average Modeled Concentration for One Item (grams/m^3) CONC	Substance Emission Rate For One Item (g/item)/sec ER_1
Chloromethane	1.24E-03	1.45E-03	1.45E-03	7.71E-12	2.16E-08	3.496E-09	3.603E-13	1.748E-09
Vinyl Chloride	2.56E-03	2.56E-03	2.56E-03	ND	ND	ND	ND	ND
1,3-Butadiene	3.98E-02	6.42E-02	2.21E-03	1.19E-08	3.34E-05	5.415E-06	5.580E-10	2.707E-06
Bromomethane	3.88E-03	3.88E-03	3.88E-03	ND	ND	ND	ND	ND
Chloroethane	2.64E-03	2.64E-03	2.64E-03	ND	ND	ND	ND	ND
Dichlorofluoromethane	4.21E-03	4.21E-03	4.21E-03	ND	ND	ND	ND	ND
Trichloroflouromethane	1.69E-03	1.69E-03	1.69E-03	3.63E-11	1.02E-07	1.648E-08	1.698E-12	8.240E-09
Pentane	1.48E-03	1.18E-03	1.18E-03	5.90E-11	1.65E-07	2.674E-08	2.756E-12	1.337E-08
Acrolein	9.86E-02	1.10E-01	2.29E-03	2.39E-08	6.70E-05	1.085E-05	1.118E-09	5.424E-06
1,1-Dichlorethene	4.05E-03	4.05E-03	4.05E-03	ND	ND	ND	ND	ND
Freon 113	7.68E-03	7.68E-03	7.68E-03	ND	ND	ND	ND	ND
Acetone	3.09E-02	3.09E-02	3.09E-02	6.66E-10	1.86E-06	3.019E-07	3.111E-11	1.510E-07
Methyl Iodide	5.81E-03	5.81E-03	5.81E-03	ND	ND	ND	ND	ND
Carbon Disulfide	3.11E-03	3.11E-03	3.11E-03	ND	ND	ND	ND	ND
Acetonitrile	1.63E-01	9.23E-02	9.23E-02	1.00E-08	2.80E-05	4.535E-06	4.673E-10	2.267E-06
3-Chloropropene	3.13E-03	3.13E-03	3.13E-03	ND	ND	ND	ND	ND
Methylene Chloride	1.35E+00	6.60E-01	2.43E-01	1.80E-07	5.03E-04	8.148E-05	8.397E-09	4.074E-05
tert-Butyl Alcohol	3.03E-03	3.03E-03	2.12E-03	ND	ND	ND	ND	ND
Acrylonitrile	3.04E-02	3.04E-02	2.17E-03	6.96E-09	1.95E-05	3.158E-06	3.254E-10	1.579E-06
trans-1,2-Dichloroethene	3.96E-03	3.96E-03	3.96E-03	ND	ND	ND	ND	ND
Methyl t-Butyl Ether	1.44E-03	3.61E-03	1.44E-03	2.82E-11	7.89E-08	1.278E-08	1.317E-12	6.388E-09
Hexane	2.47E-02	1.06E-02	3.17E-02	ND	ND	ND	ND	ND
1,1-Dichloroethane	3.97E-03	3.97E-03	3.97E-03	ND	ND	ND	ND	ND
Vinyl Acetate	3.52E-03	3.52E-03	3.52E-03	ND	ND	ND	ND	ND
cis-1,2-Dichloroethene	3.96E-03	3.96E-03	3.96E-03	ND	ND	ND	ND	ND
2-Butanone	2.95E-03	2.65E-03	2.95E-03	6.42E-10	1.80E-06	2.911E-07	2.999E-11	1.455E-07
Ethyl Acetate	3.60E-03	3.60E-03	3.60E-03	ND	ND	ND	ND	ND
Methyl Acrylate	3.52E-03	3.52E-03	3.52E-03	ND	ND	ND	ND	ND
Chloroform	4.88E-03	4.88E-03	4.88E-03	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	1.09E-02	1.64E-02	1.09E-02	8.66E-10	2.42E-06	3.928E-07	4.047E-11	1.964E-07
Carbon Tetrachloride	6.29E-03	6.29E-03	6.29E-03	ND	ND	ND	ND	ND
1,2-Dichlorethane	4.05E-03	4.05E-03	4.05E-03	9.27E-10	2.60E-06	4.207E-07	4.335E-11	2.103E-07
Benzene	2.56E-01	2.62E-01	1.28E-03	5.90E-08	1.65E-04	2.678E-05	2.760E-09	1.339E-05

Table B-1: Air Modeling Output Data for the Long Rifle .22 Caliber Ball Cartridge

Substance	Trial #1B Measured Actual Concentration (mg/m^3)	Trial #2B Measured Actual Concentration (mg/m^3)	Daily Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb./item) EF	Average Adjusted Emission Factor (lb./lb. NEW)	Total Mass of Substance Emitted (grams/item) M	Average Modeled Concentration for One Item ($grams/m^3$) CONC	Substance Emission Rate For One Item (g/item)/sec ER_1
Isooctane	4.67E-03	4.67E-03	4.67E-03	ND	ND	ND	ND	ND
Heptane	4.10E-03	4.10E-03	1.64E-02	ND	ND	ND	ND	ND
Trichloroethane	4.88E-03	4.88E-03	4.88E-03	ND	ND	ND	ND	ND
Ethyl Acrylate	4.09E-03	4.09E-03	4.09E-03	ND	ND	ND	ND	ND
1,2-Dichloropropane	4.62E-03	4.62E-03	4.62E-03	ND	ND	ND	ND	ND
Methyl Methacrylate	4.09E-03	4.09E-03	4.09E-03	ND	ND	ND	ND	ND
Dibromomethane	7.11E-03	7.11E-03	7.11E-03	ND	ND	ND	ND	ND
1,4-Dioxane	3.60E-03	3.60E-03	3.60E-03	ND	ND	ND	ND	ND
Bromodichloromethane	6.70E-03	6.70E-03	6.70E-03	ND	ND	ND	ND	ND
cis-1,3-Dichloropropene	4.54E-03	4.54E-03	4.54E-03	ND	ND	ND	ND	ND
4-Methyl-2-Pentanone	4.10E-03	4.10E-03	4.10E-03	ND	ND	ND	ND	ND
Toluene	3.02E-02	2.64E-02	2.26E-03	6.00E-09	1.68E-05	2.723E-06	2.806E-10	1.362E-06
Octane	4.67E-03	4.67E-03	4.67E-03	ND	ND	ND	ND	ND
trans-1,3-Dichloropropene	4.54E-03	4.54E-03	4.54E-03	ND	ND	ND	ND	ND
Ethyl Methacrylate	4.67E-03	4.67E-03	4.67E-03	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	5.46E-03	5.46E-03	5.46E-03	ND	ND	ND	ND	ND
Tertrachloroethene	6.78E-03	6.78E-03	6.78E-03	ND	ND	ND	ND	ND
2-Hexanone	4.10E-03	4.10E-03	4.10E-03	ND	ND	ND	ND	ND
Dibromochloromethane	8.52E-03	8.52E-03	8.52E-03	ND	ND	ND	ND	ND
1,2-Dibromoethane	7.68E-03	7.68E-03	7.68E-03	ND	ND	ND	ND	ND
Chlorobenzene	4.60E-03	4.60E-03	4.60E-03	ND	ND	ND	ND	ND
1,1,1,2-Tetrachloroethane	6.87E-03	6.87E-03	6.87E-03	ND	ND	ND	ND	ND
Ethylbenzene	8.68E-03	8.68E-03	8.68E-03	ND	ND	ND	ND	ND
m/p-Xylene	4.34E-02	3.04E-02	4.34E-02	ND	ND	ND	ND	ND
o-Xylene	4.78E-02	3.04E-02	5.65E-02	ND	ND	ND	ND	ND
Styrene	1.28E-02	1.28E-02	4.26E-03	2.93E-09	8.20E-06	1.328E-06	1.369E-10	6.642E-07
Bromoform	1.03E-02	1.03E-02	1.03E-02	ND	ND	ND	ND	ND
Cumene	1.97E-03	1.47E-03	1.97E-03	ND	ND	ND	ND	ND
1,1,2,2-Tetrachlorethane	6.87E-03	6.87E-03	6.87E-03	ND	ND	ND	ND	ND
1,2,3-Trichloropropane	6.03E-03	6.03E-03	6.03E-03	ND	ND	ND	ND	ND
Bromobenzene	6.42E-03	6.42E-03	6.42E-03	ND	ND	ND	ND	ND
4-Ethyltoluene	3.93E-03	2.95E-03	3.93E-03	ND	ND	ND	ND	ND
1,3,5-Trimethylbenzene	4.92E-03	3.93E-03	4.92E-03	ND	ND	ND	ND	ND

Table B-1: Air Modeling Output Data for the Long Rifle .22 Caliber Ball Cartridge

Substance	Trial #1B Measured Actual Concentration (mg/m^3)	Trial #2B Measured Actual Concentration (mg/m^3)	Daily Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb./item) EF	Average Adjusted Emission Factor (lb./lb. NEW)	Total Mass of Substance Emitted (grams/item) M	Average Modeled Concentration for One Item ($grams/m^3$) CONC	Substance Emission Rate For One Item (g/item)/sec ER_1
Alpha Methyl Styrene	4.83E-03	4.83E-03	4.83E-03	ND	ND	ND	ND	ND
1,2,4-Trimethylbenzene	1.47E-02	9.83E-03	1.47E-02	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	6.01E-03	6.01E-03	6.01E-03	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	6.01E-03	6.01E-03	6.01E-03	ND	ND	ND	ND	ND
Benzyl Chloride	5.18E-03	5.18E-03	5.18E-03	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	6.01E-03	6.01E-03	6.01E-03	ND	ND	ND	ND	ND
Hexachlorethane	9.68E-03	9.68E-03	9.68E-03	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	7.42E-03	7.42E-03	7.42E-03	ND	ND	ND	ND	ND
Hexachlorobutadiene	1.07E-02	1.07E-02	1.07E-02	ND	ND	ND	ND	ND
Hydrocarbons								
Methane	3.35E+00	3.61E+00	1.34E+00	5.53E-07	1.55E-03	2.509E-04	2.586E-08	1.255E-04
Ethylene	1.46E+00	1.72E+00	2.87E-02	3.83E-07	1.07E-03	1.738E-04	1.791E-08	8.691E-05
Acetylene	4.54E-01	5.24E-01	2.66E-02	1.18E-07	3.30E-04	5.349E-05	5.512E-09	2.675E-05
Ethane	1.22E-01	1.46E-01	3.07E-02	3.23E-08	9.05E-05	1.466E-05	1.511E-09	7.331E-06
Propylene	2.34E-01	2.89E-01	4.30E-02	6.31E-08	1.77E-04	2.860E-05	2.947E-09	1.430E-05
Propane	4.51E-02	4.51E-02	4.51E-02	ND	ND	ND	ND	ND
Propyne	4.00E-02	4.00E-02	4.00E-02	ND	ND	ND	ND	ND
Isobutane	5.94E-02	5.94E-02	5.94E-02	ND	ND	ND	ND	ND
1-Butene/Isobutylene	1.08E-01	1.08E-01	1.08E-01	ND	ND	ND	ND	ND
1,3-Butadiene/butane	1.65E-01	1.65E-01	1.65E-01	ND	ND	ND	ND	ND
cis-butene	5.74E-02	5.74E-02	5.74E-02	ND	ND	ND	ND	ND
1-Butyne/trans-butene	1.06E-01	1.06E-01	1.06E-01	ND	ND	ND	ND	ND
2-Butyne	5.53E-02	5.53E-02	5.53E-02	ND	ND	ND	ND	ND
n-Pentane	7.38E-02	7.38E-02	7.38E-02	ND	ND	ND	ND	ND
n-Hexane	8.81E-02	8.81E-02	8.81E-02	ND	ND	ND	ND	ND
SVOCs (8270 List)								
N-nitrosodimethylamine	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
Bis(2-chloroethyl)ether	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
Phenol	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
2-chlorophenol	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
1,3-dichlorobenzene	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
1,4-dichlorobenzene	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
1,2-dichlorobenzene	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND

Table B-1: Air Modeling Output Data for the Long Rifle .22 Caliber Ball Cartridge

Substance	Trial #1B Measured Actual Concentration (mg/m^3)	Trial #2B Measured Actual Concentration (mg/m^3)	Daily Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb./item) EF	Average Adjusted Emission Factor (lb./lb. NEW)	Total Mass of Substance Emitted (grams/item) M	Average Modeled Concentration for One Item (grams/m^3) CONC	Substance Emission Rate For One Item (g/item)/sec ER_1
Benzyl alcohol	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
Bis(2-chloroisopropyl)ether	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
2-methylphenol	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
Hexachloroethane	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
N-nitroso-di-n-propylamine	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
4-methylphenol	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
Nitrobenzene	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
Isophorone	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
2-nitrophenol	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
2,4-dimethylphenol	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
Bis(2-chloroethoxy)methane	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
2,4-dichlorophenol	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
1,2,4-trichlorobenzene	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
Naphthalene	1.53E-02	1.74E-02	1.80E-02	3.75E-09	1.05E-05	1.703E-06	1.755E-10	8.514E-07
4-chloroaniline	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
Hexachlorobutadiene	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
4-chloro-3-methylphenol	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
2-methylnaphthalene	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
Hexachlorocyclopentadiene	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
2,4,6-trichlorophenol	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
2,4,5-trichlorophenol	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
2-chloronaphthalene	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
2-nitroaniline	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
Acenaphthylene	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
Dimethylphthalate	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
2,6-dinitrotoluene	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
Acenaphthene	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
3-nitroaniline	3.56E-02	3.59E-02	3.59E-02	ND	ND	ND	ND	ND
2,4-dinitrophenol	3.56E-02	3.59E-02	3.59E-02	ND	ND	ND	ND	ND
Dibenzofuran	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
2,4-dinitrotoluene	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
4-nitrophenol	3.56E-02	3.59E-02	3.59E-02	ND	ND	ND	ND	ND
Fluorene	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND

Table B-1: Air Modeling Output Data for the Long Rifle .22 Caliber Ball Cartridge

Substance	Trial #1B Measured Actual Concentration (mg/m^3)	Trial #2B Measured Actual Concentration (mg/m^3)	Daily Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb./item) EF	Average Adjusted Emission Factor (lb./lb. NEW)	Total Mass of Substance Emitted (grams/item) M	Average Modeled Concentration for One Item ($grams/m^3$) CONC	Substance Emission Rate For One Item (g/item)/sec ER_1
4-chlorophenyl-phenylether	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
Diethylphthalate	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
4-nitroaniline	3.56E-02	3.59E-02	3.59E-02	ND	ND	ND	ND	ND
4,6-dinitro-2-methylphenol	3.56E-02	3.59E-02	3.59E-02	ND	ND	ND	ND	ND
N-nitrosodiphenylamine(1)	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
4-bromophenyl-phenylether	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
Hexachlorobenzene	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
Pentachlorophenol	3.56E-02	3.59E-02	3.59E-02	ND	ND	ND	ND	ND
Phenanthrene	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
Anthracene	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
Di-n-butylphthalate	1.78E-02	1.29E-02	1.80E-02	2.99E-09	8.37E-06	1.356E-06	1.398E-10	6.782E-07
Fluoranthene	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
Pyrene	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
Butylbenzylphthalate	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
Benzo(a)anthracene	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
Chrysene	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
Bis(2-ethylhexyl)phthalate	7.48E-02	7.19E-02	5.57E-02	5.24E-09	1.47E-05	2.378E-06	2.450E-10	1.189E-06
Di-n-octylphthalate	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
Benzo(b)fluoranthene	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
Benzo(k)fluoranthene	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
Benzo(a)pyrene	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
Dibenz(a,h)anthracene	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
Benzo(g,h,i)perylene	1.78E-02	1.80E-02	1.80E-02	ND	ND	ND	ND	ND
TO-13 PAHs								
Naphthalene	1.35E-02	1.56E-02	4.31E-04	3.25E-09	9.11E-06	1.476E-06	1.521E-10	7.381E-07
Acenaphthylene	1.60E-03	1.80E-03	3.77E-05	3.82E-10	1.07E-06	1.732E-07	1.785E-11	8.661E-08
Acenaphthene	1.07E-04	1.11E-04	3.23E-05	1.83E-11	5.12E-08	8.301E-09	8.554E-13	4.150E-09
Fluorene	2.32E-04	2.52E-04	5.03E-05	4.49E-11	1.26E-07	2.038E-08	2.100E-12	1.019E-08
Phenanthrene	3.21E-04	4.13E-04	1.47E-04	5.36E-11	1.50E-07	2.431E-08	2.505E-12	1.215E-08
Anthracene	3.56E-05	4.67E-05	1.80E-05	9.45E-12	2.64E-08	4.284E-09	4.415E-13	2.142E-09
Fluoranthene	7.30E-05	9.88E-05	3.77E-05	1.19E-11	3.33E-08	5.390E-09	5.555E-13	2.695E-09
Pyrene	1.16E-04	1.31E-04	2.69E-05	2.27E-11	6.36E-08	1.030E-08	1.062E-12	5.152E-09

Table B-1: Air Modeling Output Data for the Long Rifle .22 Caliber Ball Cartridge

Substance	Trial #1B Measured Actual Concentration (mg/m^3)	Trial #2B Measured Actual Concentration (mg/m^3)	Daily Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb./item) EF	Average Adjusted Emission Factor (lb./lb. NEW)	Total Mass of Substance Emitted (grams/item) M	Average Modeled Concentration for One Item ($grams/m^3$) CONC	Substance Emission Rate For One Item (g/item)/sec ER_1
Benzo(a)anthracene	3.03E-05	3.77E-05	1.80E-05	7.80E-12	2.18E-08	3.538E-09	3.646E-13	1.769E-09
Chrysene	3.21E-05	4.67E-05	1.80E-05	9.04E-12	2.53E-08	4.101E-09	4.226E-13	2.050E-09
Benzo(b)fluoranthene	6.95E-05	8.26E-05	1.80E-05	1.74E-11	4.88E-08	7.912E-09	8.153E-13	3.956E-09
Benzo(k)fluoranthene	5.70E-05	6.83E-05	1.80E-05	1.44E-11	4.02E-08	6.516E-09	6.714E-13	3.258E-09
Benzo(e)pyrene	1.37E-04	1.42E-04	1.80E-05	3.20E-11	8.95E-08	1.451E-08	1.495E-12	7.253E-09
Benzo(a)pyrene	1.28E-04	1.44E-04	1.80E-05	3.12E-11	8.73E-08	1.414E-08	1.457E-12	7.071E-09
Indeno(1,2,3-cd)pyrene	1.35E-04	1.63E-04	1.80E-05	3.43E-11	9.59E-08	1.555E-08	1.602E-12	7.773E-09
Dibenz(a,h)anthracene	1.78E-05	1.80E-05	1.80E-05	ND	ND	ND	ND	ND
Benzo(g,h,i)perylene	5.17E-04	5.75E-04	1.80E-05	1.25E-10	3.50E-07	5.675E-08	5.848E-12	2.838E-08
Dioxins and Furans								
2378-TCDD	3.26E-09	2.54E-09	1.03E-09	ND	ND	ND	ND	ND
12378-PECDD	6.18E-09	5.53E-09	1.34E-09	ND	ND	ND	ND	ND
123478-HXCDD	3.15E-09	2.21E-09	6.54E-10	ND	ND	ND	ND	ND
123678-HXCDD	3.43E-09	2.43E-09	7.15E-10	ND	ND	ND	ND	ND
123789-HXCDD	5.56E-09	3.92E-09	1.16E-09	ND	ND	ND	ND	ND
1234678-HPCDD	5.55E-09	3.19E-09	1.88E-09	6.61E-16	1.85E-12	3.000E-13	3.092E-17	1.500E-13
OCDD	2.86E-08	1.59E-08	1.41E-08	2.39E-15	6.70E-12	1.086E-12	1.119E-16	5.431E-13
2378-TCDF	3.91E-09	3.17E-09	9.42E-10	ND	ND	ND	ND	ND
12378-PECDF	4.59E-09	3.49E-09	1.05E-09	ND	ND	ND	ND	ND
23478-PECDF	1.31E-08	1.26E-08	1.89E-09	ND	ND	ND	ND	ND
123478-HXCDF	4.51E-09	3.58E-09	9.21E-10	ND	ND	ND	ND	ND
123678-HXCDF	4.72E-09	3.51E-09	9.74E-10	ND	ND	ND	ND	ND
123789-HXCDF	1.51E-09	9.79E-10	6.51E-10	ND	ND	ND	ND	ND
234678-HXCDF	1.63E-09	1.02E-09	3.57E-10	ND	ND	ND	ND	ND
1234678-HPCDF	2.56E-09	1.89E-09	9.30E-10	2.54E-16	7.12E-13	1.154E-13	1.189E-17	5.768E-14
1234789-HPCDF	3.32E-09	1.96E-09	7.90E-10	ND	ND	ND	ND	ND
OCDF	1.11E-08	1.53E-09	9.70E-10	1.35E-15	3.79E-12	6.138E-13	6.325E-17	3.069E-13
Energetics								
Nitrobenzene	3.47E-03	3.49E-03	NA	ND	ND	ND	ND	ND
2-Nitrotoluene	3.47E-03	3.49E-03	NA	ND	ND	ND	ND	ND
3-Nitrotoluene	3.47E-03	3.49E-03	NA	ND	ND	ND	ND	ND
4-Nitrotoluene	3.47E-03	3.49E-03	NA	ND	ND	ND	ND	ND
Nitroglycerine	2.60E-02	3.31E-02	NA	6.79E-09	1.90E-05	3.079E-06	3.173E-10	1.539E-06

Table B-1: Air Modeling Output Data for the Long Rifle .22 Caliber Ball Cartridge

Substance	Trial #1B Measured Actual Concentration (mg/m^3)	Trial #2B Measured Actual Concentration (mg/m^3)	Daily Measured Background Concentration (mg/m^3)	Average Adjusted Emission Factor (lb./item) EF	Average Adjusted Emission Factor (lb./lb. NEW)	Total Mass of Substance Emitted (grams/item) M	Average Modeled Concentration for One Item ($grams/m^3$) CONC	Substance Emission Rate For One Item (g/item)/sec ER_1
1,3-Dinitrobenzene	3.47E-03	3.49E-03	NA	ND	ND	ND	ND	ND
2,6-Dinitrotoluene	3.47E-03	3.49E-03	NA	ND	ND	ND	ND	ND
2,4-Dinitrotoluene	3.47E-03	3.49E-03	NA	ND	ND	ND	ND	ND
1,3,5-Trinitrobenzene	3.47E-03	3.49E-03	NA	ND	ND	ND	ND	ND
2,4,6-Trinitrotoluene	3.47E-03	3.49E-03	NA	ND	ND	ND	ND	ND
RDX	3.47E-03	3.49E-03	NA	ND	ND	ND	ND	ND
4-Amino-2,6-Dinitrotoluene	3.47E-03	3.49E-03	NA	ND	ND	ND	ND	ND
2-Amino-4,6-Dinitrotoluene	3.47E-03	3.49E-03	NA	ND	ND	ND	ND	ND
Tetryl	3.47E-03	3.49E-03	NA	ND	ND	ND	ND	ND
HMX	6.94E-03	6.98E-03	NA	ND	ND	ND	ND	ND
Pentaerythritoltetranitrate	6.94E-03	6.98E-03	NA	ND	ND	ND	ND	ND
Dibutyl phthalate	8.68E-02	8.72E-02	NA	ND	ND	ND	ND	ND
Dioctyl phthalate	8.68E-02	8.72E-02	NA	ND	ND	ND	ND	ND
Diphenylamine	8.68E-02	8.72E-02	NA	ND	ND	ND	ND	ND

Footnotes:

[1]ATC = Aberdeen Test Center (for additional information on the data, refer to the Firing Point Emission Study)

NA = Not Applicable

ND = Not Detected

APPENDIX C

HEALTH-BASED SCREENING LEVELS AND ACUTE TOXICITY VALUES

Appendix C: Health-Based Screening Levels and Acute Toxicity Values

Substance	CAS#	PRG	Toxicity Endpoint	RBC	Toxicity Endpoint	NAAQS	HBSL	Toxicity Endpoint	ERPG	TEEL	AEGL	ATV	ATV Source
1,1,1,2-Tetrachloroethane	630-20-6	2.60E-01	c	2.41E-01	c		2.41E-01	c		5.15E+04		5.15E+04	T
1,1,1-Trichloroethane	71-55-6	1.04E+03	nc	2.30E+03	nc		1.04E+03	nc	1.94E+06	1.91E+06	1.25E+06	1.25E+06	A
1,1,2,2-Tetrachloroethane	79-34-5	3.31E-02	c	3.13E-02	c		3.13E-02	c		2.06E+04		2.06E+04	T
1,1,2-Trichloroethane	79-00-5	1.20E-01	c	1.12E-01	c		1.12E-01	c		1.64E+05		1.64E+05	T
1,1-Dichloroethane	75-34-3	5.21E+02	nc	5.11E+02	nc		5.11E+02	nc		1.21E+06		1.21E+06	T
1,1-Dichloroethene	75-35-4		nc	3.58E-02	c		3.58E-02	c		7.92E+04		7.92E+04	T
1,2,3-Trichloropropane	96-18-4	9.61E-04	c	3.13E-03	c		9.61E-04	c		6.03E+04		6.03E+04	T
1,2,4-Trichlorobenzene	120-82-1	2.08E+02	nc	2.08E+02	nc		2.08E+02	nc		3.71E+04		3.71E+04	T
1,2,4-Trimethylbenzene	95-63-6	6.21E+00	nc	6.21E+00	nc		6.21E+00	nc		1.80E+05		1.80E+05	T
1,2-Dibromoethane	106-93-4	8.73E-03	c	8.24E-03	c		8.24E-03	c		1.54E+05		1.54E+05	T
1,2-Dichlorobenzene	95-50-1	2.09E+02	nc	3.29E+02	nc		2.09E+02	nc		3.01E+05		3.01E+05	T
1,2-Dichloroethane	107-06-2	7.39E-02	c	6.88E-02	c		6.88E-02	c		8.08E+03		8.08E+03	T
1,2-Dichloropropane	78-87-5	9.89E-02	c	9.21E-02	c		9.21E-02	c		5.08E+05		5.08E+05	T
1,3,5-Trimethylbenzene	108-67-8	6.21E+00	nc	6.21E+00	nc		6.21E+00	nc		3.68E+05		3.68E+05	T
1,3,5-Trinitrobenzene	99-35-4	1.10E+02	nc	1.10E+02	nc		1.10E+02	nc		3.00E+04		3.00E+04	T
1,3-Butadiene	106-99-0	3.74E-03	c	3.48E-03	c		3.48E-03	c	2.20E+04	2.21E+04		2.20E+04	E
1,3-Dichlorobenzene	541-73-1	3.29E+00	nc	1.10E+02	nc		3.29E+00	nc		3.61E+04		3.61E+04	T

Substance	CAS#	PRG	Toxicity Endpoint	RBC	Toxicity Endpoint	NAAQS	HBSL	Toxicity Endpoint	ERPG	TEEL	AEGL	ATV	ATV Source
1,3-Dinitrobenzene	99-65-0	3.65E-01	nc	3.65E-01	nc		3.65E-01	nc		3.00E+03		3.00E+03	T
1,4-Dichlorobenzene	106-46-7	3.06E-01	c	2.85E-01	c		2.85E-01	c		6.61E+05		6.61E+05	T
1,4-Dioxane	123-91-1	6.11E-01	c	5.69E-01	c		5.69E-01	c		9.00E+04		9.00E+04	T
1234678-HPCDD	35822-46-9												
1234678-HPCDF	67562-39-4												
1234789-HPCDF	55673-89-7												
123478-HXCDD	39227-28-6												
123478-HXCDF	70648-26-9									8.00E+00		8.00E+00	T
123678-HXCDD	57653-85-7									1.50E+01		1.50E+01	T
123678-HXCDF	57117-44-9									2.00E+00		2.00E+00	T
123789-HXCDD	19408-74-3	1.48E-06	c	1.38E-06	c		1.38E-06	c					
123789-HXCDF	72918-21-9												
12378-PECDD	40321-76-4									2.00E+00		2.00E+00	T
12378-PECDF	57117-41-6												
1-Butene/Isobutylene	106-98-9									6.87E+06		6.87E+06	T
2,4,5-trichlorophenol	95-95-4	3.65E+02	nc	3.65E+02	nc		3.65E+02	nc		3.00E+04		3.00E+04	T
2,4,6-trichlorophenol	88-06-2	6.20E-01	c	6.26E-01	c		6.20E-01	c		3.00E+04		3.00E+04	T
2,4,6-Trinitrotoluene	118-96-7	2.24E-01	c	2.09E-01	c		2.09E-01	c		2.50E+04		2.50E+04	T
2,4-dichlorophenol	120-83-2	1.10E+01	nc	1.10E+01	nc		1.10E+01	nc		3.00E+04		3.00E+04	T

Substance	CAS#	PRG	Toxicity Endpoint	RBC	Toxicity Endpoint	NAAQS	HBSL	Toxicity Endpoint	ERPG	TEEL	AEGL	ATV	ATV Source
2,4-dimethylphenol	105-67-9	7.30E+01	nc	7.30E+01	nc		7.30E+01	nc					
2,4-dinitrophenol	51-28-5	7.30E+00	nc	7.30E+00	nc		7.30E+00	nc		7.50E+03		7.50E+03	T
2,4-Dinitrotoluene	121-14-2	7.30E+00	nc	7.30E+00	nc		7.30E+00	nc		6.00E+02		6.00E+02	T
2,5-Dimethylbenzaldehyde	5779-94-2												
2,6-dinitrotoluene	606-20-2	3.65E+00	nc	3.65E+00	nc		3.65E+00	nc		6.00E+02		6.00E+02	T
234678-HXCDF	60851-34-5									2.00E+00		2.00E+00	T
23478-PECDF	57117-31-4												
2378-TCDD	1746-01-6	4.48E-08	c	4.17E-08	c		4.17E-08	c		4.00E+00		4.00E+00	T
2378-TCDF	51207-31-9									2.00E+00		2.00E+00	T
2-Amino-4,6-Dinitrotoluene	35572-78-2									1.50E+04		1.50E+04	T
2-Butanone	78-93-3	1.04E+03	nc	1.04E+03	nc		1.04E+03	nc		8.85E+05		8.85E+05	T
2-Butyne	503-17-3												
2-chloronaphthalene	91-58-7	2.92E+02	nc	2.92E+02	nc		2.92E+02	nc		6.00E+02		6.00E+02	T
2-chlorophenol	95-57-8	1.83E+01	nc	1.83E+01	nc		1.83E+01	nc		5.25E+03		5.25E+03	T
2-Hexanone	591-78-6			5.11E+00	nc		5.11E+00	nc		4.09E+04		4.09E+04	T
2-methylnaphthalene	91-57-6			7.30E+01	nc		7.30E+01	nc		2.00E+04		2.00E+04	T
2-methylphenol	95-48-7	1.83E+02	nc	1.83E+02	nc		1.83E+02	nc					
2-nitroaniline	88-74-4	2.09E-01	nc	2.08E-01	nc		2.08E-01	nc					
2-nitrophenol	88-75-5												

Substance	CAS#	PRG	Toxicity Endpoint	RBC	Toxicity Endpoint	NAAQS	HBSL	Toxicity Endpoint	ERPG	TEEL	AEGL	ATV	ATV Source
2-Nitrotoluene	88-72-2	3.65E+01	nc	3.65E+01	nc		3.65E+01	nc					
3-Chloropropene	107-05-1	1.04E+00	nc						9.39E+03	9.39E+03		9.39E+03	E
3-nitroaniline	99-09-2												
3-Nitrotoluene	99-08-1	3.65E+01	nc	7.30E+01	nc		3.65E+01	nc					
4,6-dinitro-2-methylphenol	534-52-1			3.65E-01	nc		3.65E-01	nc		5.00E+02		5.00E+02	T
4-Amino-2,6-Dinitrotoluene	19406-51-0												
4-bromophenyl-phenylethe	101-55-3												
4-chloro-3-methylphenol	59-50-7									2.00E+04		2.00E+04	T
4-chloroaniline	106-47-8	1.46E+01	nc	1.46E+01	nc		1.46E+01	nc		3.00E+04		3.00E+04	T
4-chlorophenyl-phenylether	7005-72-3												
4-Ethyltoluene	622-96-8									1.25E+05		1.25E+05	T
4-Methyl-2-Pentanone	108-10-1	8.34E+01	nc	7.30E+01	nc		7.30E+01	nc		3.07E+05		3.07E+05	T
4-methylphenol	106-44-5	1.83E+01	nc	1.83E+01	nc		1.83E+01	nc					
4-nitroaniline	100-01-6									9.00E+03		9.00E+03	T
4-nitrophenol	100-02-7	2.92E+01	nc	2.90E+01	nc		2.90E+01	nc		3.00E+04		3.00E+04	T
4-Nitrotoluene	99-99-0	3.65E+01	nc	3.65E+01	nc		3.65E+01	nc		3.37E+04		3.37E+04	T
acenaphthene	83-32-9	2.19E+02	nc	2.19E+02	nc		2.19E+02	nc		1.25E+03		1.25E+03	T
Acenaphthylene	208-96-8									2.00E+02		2.00E+02	T
Acetaldehyde	75-07-0	8.73E-01	c	8.13E-01	c		8.13E-01	c	1.80E+04	1.80E+04		1.80E+04	E

Substance	CAS#	PRG	Toxicity Endpoint	RBC	Toxicity Endpoint	NAAQS	HBSL	Toxicity Endpoint	ERPG	TEEL	AEGL	ATV	ATV Source
Acetone	67-64-1	3.65E+02	nc	3.65E+02	nc		3.65E+02	nc		2.37E+06		2.37E+06	T
Acetonitrile	75-05-8	6.20E+01	nc	6.21E+01	nc		6.20E+01	nc		1.01E+05		1.01E+05	T
Acetylene	74-86-2												
Acrolein	107-02-8	2.09E-02	nc	2.08E-02	nc		2.08E-02	nc	2.30E+02	2.29E+02		2.30E+02	E
Acrylonitrile	107-13-1	2.83E-02	c	2.61E-02	c		2.61E-02	c	2.17E+04	2.17E+04		2.17E+04	E
Alpha Methyl Styrene	98-83-9	2.56E+02	nc	2.56E+02	nc		2.56E+02	nc					
Aluminum	7429-90-5	5.11E+00	nc	3.65E+00	nc		3.65E+00	nc		3.00E+04		3.00E+04	T
Ammonia (NH3)	7664-41-7	1.04E+02	nc	1.04E+02	nc		1.04E+02	nc	1.75E+04	1.75E+04		1.75E+04	E
anthracene	120-12-7	1.10E+03	nc	1.10E+03	nc		1.10E+03	nc		6.00E+03		6.00E+03	T
Antimony	7440-36-0			1.46E+00	nc		1.46E+00	nc		1.50E+03		1.50E+03	T
Arsenic	7440-38-2	4.47E-04	c	4.15E-04	c		4.15E-04	c		3.00E+01		3.00E+01	T
Barium	7440-39-3	5.21E-01	nc	5.11E-01	nc		5.11E-01	nc		1.50E+03		1.50E+03	T
Benzaldehyde	100-52-7	3.65E+02	nc	3.65E+02	nc		3.65E+02	nc		1.50E+04		1.50E+04	T
Benzene	71-43-2	2.49E-01	c	2.16E-01	c		2.16E-01	c	1.56E+05	1.60E+05		1.56E+05	E
benzo(a)anthracene	56-55-3	2.17E-02	c	8.58E-03	c		8.58E-03	c		6.00E+02		6.00E+02	T
benzo(a)pyrene	50-32-8	2.17E-03	c	2.02E-03	c		2.02E-03	c		7.50E+03		7.50E+03	T
benzo(b)fluoranthene	205-99-2	2.17E-02	c	8.58E-03	c		8.58E-03	c					
Benzo(e)pyrene	192-97-2												
benzo(g,h,i)perylene	191-24-2									3.00E+04		3.00E+04	T

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benzo(k)fluoranthene	207-08-9	2.17E-01	c	8.58E-02	c		8.58E-02	c					
benzyl alcohol	100-51-6	1.10E+03	nc	1.10E+03	nc		1.10E+03	nc		5.53E+04		5.53E+04	T
Benzyl Chloride	100-44-7	3.96E-02	c	3.68E-02	c		3.68E-02	c	5.20E+03	5.17E+03		5.20E+03	E
Beryllium	7440-41-7	8.00E-04	c	7.45E-04	c		7.45E-04	c		5.00E+00		5.00E+00	T
bis(2-chloroethoxy)methan	111-91-1												
bis(2-chloroethyl)ether	111-44-4	5.82E-03	c	5.69E-03	c		5.69E-03	c		5.85E+04		5.85E+04	T
bis(2-chloroisopropyl)ether	108-60-1	1.92E-01	c	1.79E-01	c		1.79E-01	c		6.99E+04		6.99E+04	T
Bis(2-ethylhexyl)phthalate	117-81-7	4.80E-01	c	4.47E-01	c		4.47E-01	c		1.00E+04		1.00E+04	T
Bromobenzene	108-86-1	1.04E+01	nc							4.82E+04		4.82E+04	T
Bromodichloromethane	75-27-4	1.08E-01	c	1.01E-01	c		1.01E-01	c		4.00E+03		4.00E+03	T
Bromoform	75-25-2	1.75E+00	c	1.61E+00	c		1.61E+00	c		6.20E+03		6.20E+03	T
Bromomethane	74-83-9	5.21E+00	nc	5.11E+00	nc		5.11E+00	nc		5.82E+04		5.82E+04	T
butylbenzylphthalate	85-68-7	7.30E+02	nc	7.30E+02	nc		7.30E+02	nc		5.00E+05		5.00E+05	T
Butyraldehyde	123-72-8									7.38E+04		7.38E+04	T
Cadmium	7440-43-9	1.07E-03	c	9.94E-04	c		9.94E-04	c		3.00E+01		3.00E+01	T
Calcium	7440-70-2									3.00E+04		3.00E+04	T
Carbon Dioxide (CO2)	124-38-9									5.40E+07		5.40E+07	T
Carbon Disulfide	75-15-0	7.30E+02	nc	7.30E+02	nc		7.30E+02	nc		3.11E+04		3.11E+04	T
Carbon Monoxide (CO)	630-08-0					1.00E+04	1.00E+04	nc	2.30E+05	2.28E+05		2.30E+05	E

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Carbon Tetrachloride	56-23-5	1.28E-01	c	1.18E-01	c		1.18E-01	c	1.28E+05	1.26E+05		1.28E+05	E
Chlorobenzene	108-90-7	6.21E+01	nc	6.21E+01	nc		6.21E+01	nc		1.38E+05		1.38E+05	T
Chlorodifluoromethane	75-45-6	5.11E+04	nc	5.11E+04	nc		5.11E+04	nc		4.41E+06		4.41E+06	T
Chloroethane	75-00-3	2.32E+00	c	2.16E+00	c		2.16E+00	c		2.64E+06		2.64E+06	T
Chloroform	67-66-3	8.35E-02	c	7.73E-02	c		7.73E-02	c		9.76E+03		9.76E+03	T
Chloromethane	74-87-3	1.07E+00	c	1.79E+00	c		1.07E+00	c		2.06E+05		2.06E+05	T
Chromium	7440-47-3		c	1.53E-04	c		1.53E-04	c		1.50E+03		1.50E+03	T
chrysene	218-01-9	2.17E+00	c	8.58E-01	c		8.58E-01	c		2.00E+02		2.00E+02	T
cis-1,2-Dichloroethene	156-59-2	3.65E+01	nc	3.65E+01	nc		3.65E+01	nc		7.92E+05	5.54E+05	5.54E+05	A
cis-1,3-Dichloropropene	10061-01-5												
cis-butene	25167-67-3									1.72E+04		1.72E+04	T
Cobalt	7440-48-4			1.83E-02	nc		1.83E-02	nc		6.00E+01		6.00E+01	T
Copper	7440-50-8			1.46E+02	nc		1.46E+02	nc		3.00E+03		3.00E+03	T
Crotonaldehyde	4170-30-3	3.54E-03	c						5.72E+03	5.72E+03		5.72E+03	E
Cumene	98-82-8	4.02E+02	nc	4.02E+02	nc		4.02E+02	nc		2.46E+05		2.46E+05	T
dibenz(a,h)anthracene	53-70-3	2.17E-03	c	8.58E-04	c		8.58E-04	c		3.00E+04		3.00E+04	T
dibenzofuran	132-64-9	1.46E+01	nc	1.46E+01	nc		1.46E+01	nc					
Dibromochloromethane	124-48-1	8.00E-02	c	7.45E-02	c		7.45E-02	c		6.00E+03		6.00E+03	T
Dibromomethane	74-95-3	3.65E+01	nc	3.65E+01	nc		3.65E+01	nc		2.50E+05		2.50E+05	T

Substance	CAS#	PRG	Toxicity Endpoint	RBC	Toxicity Endpoint	NAAQS	HBSL	Toxicity Endpoint	ERPG	TEEL	AEGL	ATV	ATV Source
Dibutyl Phthalate	84-74-2	3.65E+02	nc	3.65E+02	nc		3.65E+02	nc		1.50E+04		1.50E+04	T
Dichlorodifluoromethane	75-71-8	2.09E+02	nc	1.83E+02	nc		1.83E+02	nc		1.48E+07		1.48E+07	T
diethylphthalate	84-66-2	2.92E+03	nc	2.92E+03	nc		2.92E+03	nc		1.50E+04		1.50E+04	T
dimethylphthalate	131-11-3	3.65E+04	nc	3.65E+04	nc		3.65E+04	nc		1.50E+04		1.50E+04	T
di-n-octylphthalate	117-84-0	7.30E+01	nc	7.30E+01	nc		7.30E+01	nc		1.50E+05		1.50E+05	T
Diphenylamine	122-39-4	9.13E+01	nc	9.13E+01	nc		9.13E+01	nc		3.00E+04		3.00E+04	T
Ethane	74-84-0												
Ethyl Acetate	141-78-6	3.29E+03	nc	3.29E+03	nc		3.29E+03	nc		1.44E+06		1.44E+06	T
Ethyl Acrylate	140-88-5	1.40E-01	c							6.14E+04		6.14E+04	T
Ethyl Methacrylate	97-63-2	3.29E+02	nc	3.29E+02	nc		3.29E+02	nc					
Ethylbenzene	100-41-4	1.06E+03	nc	1.06E+03	nc		1.06E+03	nc		5.43E+05		5.43E+05	T
Ethylene	74-85-1									4.60E+05		4.60E+05	T
fluoranthene	206-44-0	1.46E+02	nc	1.46E+02	nc		1.46E+02	nc		3.00E+01		3.00E+01	T
Fluorene	86-73-7	1.46E+02	nc	1.46E+02	nc		1.46E+02	nc		7.50E+04		7.50E+04	T
Formaldehyde	50-00-0	1.48E-01	c	1.39E-01	c		1.39E-01	c	1.23E+03	1.23E+03		1.23E+03	E
Freon 113	76-13-1	3.13E+04	nc	3.14E+04	nc		3.13E+04	nc		9.58E+06		9.58E+06	T
Freon 114	76-14-2									2.10E+07		2.10E+07	T
Heptane	142-82-5									1.80E+06		1.80E+06	T
hexachlorobenzene	118-74-1	4.18E-03	c	3.91E-03	c		3.91E-03	c		7.50E+01		7.50E+01	T

Substance	CAS#	PRG	Toxicity Endpoint	RBC	Toxicity Endpoint	NAAQS	HBSL	Toxicity Endpoint	ERPG	TEEL	AEGL	ATV	ATV Source
Hexachlorobutadiene	87-68-3	8.62E-02	c	8.03E-02	c		8.03E-02	c	3.21E+04	3.20E+04		3.21E+04	E
hexachlorocyclopentadiene	77-47-4	7.30E-02	nc	7.30E-02	nc		7.30E-02	nc		2.23E+02		2.23E+02	T
Hexachloroethane	67-72-1	4.80E-01	c	4.47E-01	c		4.47E-01	c		2.90E+04		2.90E+04	T
Hexaldehyde	66-25-1												
Hexane	110-54-3	2.09E+02	nc	2.08E+02	nc		2.08E+02	nc		5.28E+05		5.28E+05	T
HMX	2691-41-0	1.83E+02	nc	1.83E+02	nc		1.83E+02	nc					
Hydrogen bromide	10035-10-6									9.93E+03		9.93E+03	T
Hydrogen chloride	7647-01-0	2.08E+01	nc	2.08E+01	nc		2.08E+01	nc	4.50E+03	4.47E+03	2.70E+03	2.70E+03	A
Hydrogen Cyanide	74-90-8	3.13E+00	nc	3.14E+00	nc		3.13E+00	nc		5.17E+03		5.17E+03	T
Hydrogen fluoride	7664-39-3								1.60E+03	1.64E+03	1.60E+03	1.60E+03	A
indeno(1,2,3-cd)pyrene	193-39-5	2.17E-02	c	8.58E-03	c		8.58E-03	c					
Isobutane	75-28-5									9.52E+05		9.52E+05	T
Isooctane	540-84-1									3.50E+05		3.50E+05	T
isophorone	78-59-1	7.08E+00	c	6.59E+00	c		6.59E+00	c		2.83E+04		2.83E+04	T
Isovaleraldehyde	590-86-3												
Lead	7439-92-1					2.00E+00	2.00E+00	nc		1.50E+02		1.50E+02	T
m/p-Xylene	108-38-3 10	7.30E+02	nc	7.30E+03	nc		7.30E+02	nc		6.51E+05		6.51E+05	T
Magnesium	7439-95-4									3.00E+04		3.00E+04	T
Manganese	7439-96-5	5.11E-02	nc	5.22E-02	nc		5.11E-02	nc		3.00E+03		3.00E+03	T

Substance	CAS#	PRG	Toxicity Endpoint	RBC	Toxicity Endpoint	NAAQS	HBSL	Toxicity Endpoint	ERPG	TEEL	AEGL	ATV	ATV Source
Methane	74-82-8									3.30E+06		3.30E+06	T
Methyl Acrylate	96-33-3	1.10E+02	nc	1.10E+02	nc		1.10E+02	nc					
Methyl Iodide	74-88-4								1.45E+05	1.45E+05		1.45E+05	E
Methyl Methacrylate	80-62-6	7.30E+02	nc	7.30E+02	nc		7.30E+02	nc		4.09E+05		4.09E+05	T
Methyl t-Butyl Ether	1634-04-4	3.13E+03	nc	3.13E+03	nc		3.13E+03	nc		4.32E+05		4.32E+05	T
Methylene Chloride	75-09-2	4.09E+00	c	3.79E+00	c		3.79E+00	c	6.96E+05	6.94E+05		6.96E+05	E
naphthalene	91-20-3	3.13E+00	nc	3.29E+00	nc		3.13E+00	nc		7.86E+04		7.86E+04	T
Nickel	7440-02-0			7.30E+01	nc		7.30E+01	nc		3.00E+03		3.00E+03	T
Nitric Acid	7697-37-2									2.58E+03	1.30E+03	1.30E+03	A
Nitrobenzene	98-95-3	2.09E+00	nc	2.19E+00	nc		2.09E+00	nc		1.51E+04		1.51E+04	T
Nitroglycerine	55-63-0	4.80E-01	c	4.47E-01	c		4.47E-01	c					
n-nitrosodimethylamine	62-75-9	1.37E-04	c	1.23E-04	c		1.23E-04	c		2.50E+03		2.50E+03	T
n-nitroso-di-n-propylamine	621-64-7	9.61E-04	c	8.94E-04	c		8.94E-04	c		2.00E+02		2.00E+02	T
n-nitrosodiphenylamine(1)	86-30-6	1.37E+00	c	1.28E+00	c		1.28E+00	c					
o,m,p-Tolualdehyde	1334-78-7												
OCDD	3268-87-9									1.50E+02		1.50E+02	T
OCDF	39001-02-0									3.00E+02		3.00E+02	T
Octane	111-65-9												
Oxides of Nitrogen (NOx)	10102-43-9			3.65E+02	nc	1.00E+02	1.00E+02	nc		3.08E+04		3.08E+04	T

Substance	CAS#	PRG	Toxicity Endpoint	RBC	Toxicity Endpoint	NAAQS	HBSL	Toxicity Endpoint	ERPG	TEEL	AEGL	ATV	ATV Source
o-Xylene	95-47-6	7.30E+02	nc	7.30E+03	nc		7.30E+02	nc		6.51E+05		6.51E+05	T
Particulate Cyanide	57-12-5			7.30E+01	nc		7.30E+01	nc		5.00E+03		5.00E+03	T
Particulate Matter <10 micr	PM10		nc			5.00E+01	5.00E+01	nc					
Particulate Matter <2.5 mic	PM2.5		nc			1.50E+01	1.50E+01	nc					
pentachlorophenol	87-86-5	5.60E-02	c	5.22E-02	c		5.22E-02	c		1.50E+03		1.50E+03	T
Pentaerythritoltetranitrate	78-11-5									5.00E+01		5.00E+01	T
Pentane	109-66-0									1.80E+06		1.80E+06	T
phenanthrene	85-01-8									2.00E+03		2.00E+03	T
phenol	108-95-2	2.19E+03	nc	2.19E+03	nc		2.19E+03	nc		3.85E+04		3.85E+04	T
Phosphoric acid	7664-38-2	1.04E+01	nc	1.06E+01	nc		1.04E+01	nc		3.00E+03		3.00E+03	T
Propane	74-98-6									3.78E+06		3.78E+06	T
Proprionaldehyde	123-38-6									7.50E+04		7.50E+04	T
Propylene	115-07-1												
Propyne	74-99-7									2.79E+06		2.79E+06	T
pyrene	129-00-0	1.10E+02	nc	1.10E+02	nc		1.10E+02	nc		1.50E+04		1.50E+04	T
RDX	121-82-4	6.11E-02	c	5.69E-02	c		5.69E-02	c					
Selenium	7782-49-2			1.83E+01	nc		1.83E+01	nc		6.00E+02		6.00E+02	T
Silver	7440-22-4			1.83E+01	nc		1.83E+01	nc		3.00E+02		3.00E+02	T
Styrene	100-42-5	1.06E+03	nc	1.04E+03	nc		1.04E+03	nc	2.13E+05	2.13E+05		2.13E+05	E

Substance	CAS#	PRG	Toxicity Endpoint	RBC	Toxicity Endpoint	NAAQS	HBSL	Toxicity Endpoint	ERPG	TEEL	AEGL	ATV	ATV Source
Sulfur Dioxide (SO2)	7446-09-5					8.00E+01	8.00E+01	nc	7.89E+02	7.86E+02		7.89E+02	E
Sulfuric Acid	7664-93-9								2.00E+03	2.00E+03		2.00E+03	E
tert-Butyl Alcohol	75-65-0									4.55E+05		4.55E+05	T
Tetrachloroethene	127-18-4	3.31E+00	c	3.13E+00	c		3.13E+00	c		6.78E+05		6.78E+05	T
Tetryl	479-45-8	3.65E+01	nc	3.65E+01	nc		3.65E+01	nc					
Thallium	7440-28-0			2.56E-01	nc		2.56E-01	nc		3.00E+02		3.00E+02	T
Toluene	108-88-3	4.02E+02	nc	4.16E+02	nc		4.02E+02	nc	1.88E+05	1.89E+05		1.88E+05	E
Total Suspended Particulat	12789-66-1					5.00E+01	5.00E+01	nc					
trans-1,2-Dichloroethene	156-60-5	7.30E+01	nc	7.30E+01	nc		7.30E+01	nc		4.95E+04	1.11E+06	1.11E+06	A
trans-1,3-Dichloropropene	10061-02-6												
Trichlorofluoromethane	75-69-4	7.30E+02	nc	7.30E+02	nc		7.30E+02	nc		2.81E+06		2.81E+06	T
Valeraldehyde	110-62-3												
Vanadium	7440-62-2			2.56E+01	nc		2.56E+01	nc		1.50E+02		1.50E+02	T
Vinyl Acetate	108-05-4	2.09E+02	nc	2.08E+02	nc		2.08E+02	nc	1.92E+04	1.76E+04		1.92E+04	E
Vinyl Chloride	75-01-4	2.17E-01	c	7.20E-02	c		7.20E-02	c		1.28E+04		1.28E+04	T
Zinc	7440-66-6			1.10E+03	nc		1.10E+03	nc		3.00E+04		3.00E+04	T

Substance	CAS#	PRG	Toxicity Endpoint	RBC	Toxicity Endpoint	NAAQS	HBSL	Toxicity Endpoint	ERPG	TEEL	AEGL	ATV	ATV Source

CAS# = Chemical Abstract Service Number
PRG = Preliminary Remediation Goal (µg/m³)
RBC = Risk-Based Concentration (µg/m³)
NAAQS = National Ambient Air Quality Standard (µg/m³)
HBSL = health-based screening level (µg/m³)
ERPG (E) = Emergency Response Planning Guideline (µg/m³)
TEEL (T) = Temporary Emergency Exposure Limit (µg/m³)
AEGL (A) = Acute Exposure Guideline Level (µg/m³)
c = carcinogen
nc = noncarcinogen

APPENDIX D

RISK ASSESSMENT DATA

Table D-1: Comparison of Modeled Air Concentrations with Health-Based Values

Long Rifle .22 Caliber Ball Cartridge ***Modeled Distance (meters) 100*** ***DODIC:*** A106

*Substance**	*CAS#*	*CONC*	*Cchronic*	*Cchr/HBSL*	*Cchr/HBSL>1?*	*Cacute*	*Cact/ATV*	*Cact/ATV>1?*
1,1,1-Trichloroethane	71-55-6	4.05E-11	1.68E-06	1.61E-09	☐	4.50E-04	3.60E-10	☐
1,2-Dichloroethane	107-06-2	4.33E-11	7.72E-07	1.12E-05	☐	1.93E-03	2.38E-07	☐
1,3-Butadiene	106-99-0	5.58E-10	9.93E-06	2.85E-03	☐	6.20E-03	2.82E-07	☐
1234678-HPCDD	35822-46-9	3.09E-17	1.28E-12		☐	3.44E-10		☐
1234678-HPCDF	67562-39-4	1.19E-17	4.94E-13		☐	1.32E-10		☐
2-Butanone	78-93-3	3.00E-11	1.25E-06	1.19E-09	☐	1.33E-03	1.51E-09	☐
Acenaphthene	83-32-9	8.55E-13	3.55E-08	1.62E-10	☐	3.80E-05	3.04E-08	☐
Acenaphthylene	208-96-8	1.79E-11	7.42E-07		☐	7.93E-04	3.97E-06	☐
Acetaldehyde	75-07-0	1.21E-09	2.16E-05	2.65E-05	☐	1.35E-02	7.48E-07	☐
Acetone	67-64-1	3.11E-11	1.29E-06	3.54E-09	☐	1.38E-03	5.83E-10	☐
Acetonitrile	75-05-8	4.67E-10	1.94E-05	3.13E-07	☐	2.08E-02	2.06E-07	☐
Acetylene	74-86-2	5.51E-09	2.29E-04		☐	6.12E-02		☐
Acrolein	107-02-8	1.12E-09	4.64E-05	2.23E-03	☐	1.24E-02	5.40E-05	☐
Acrylonitrile	107-13-1	3.25E-10	5.79E-06	2.22E-04	☐	3.62E-03	1.67E-07	☐
Anthracene	120-12-7	4.41E-13	1.83E-08	1.67E-11	☐	1.96E-05	3.27E-09	☐
Antimony	7440-36-0	4.06E-10	1.69E-05	1.16E-05	☐	1.81E-02	1.20E-05	☐
Benzene	71-43-2	2.76E-09	4.91E-05	2.27E-04	☐	3.07E-02	1.97E-07	☐
Benzo(a)anthracene	56-55-3	3.65E-13	6.49E-09	7.56E-07	☐	1.62E-05	2.70E-08	☐

Long Rifle .22 Caliber Ball Cartridge *Modeled Distance (meters) 100* ***DODIC:*** A106

*Substance**	*CAS#*	*CONC*	*Cchronic*	*Cchr/HBSL*	*Cchr/HBSL>1?*	*Cacute*	*Cact/ATV*	*Cact/ATV>1?*
Benzo(a)pyrene	50-32-8	1.46E-12	2.59E-08	1.28E-05	☐	6.48E-05	8.64E-09	☐
Benzo(b)fluoranthene	205-99-2	8.15E-13	1.45E-08	1.69E-06	☐	9.06E-06		☐
Benzo(e)pyrene	192-97-2	1.49E-12	6.21E-08		☐	1.66E-05		☐
Benzo(g,h,i)perylene	191-24-2	5.85E-12	2.43E-07		☐	2.60E-04	8.66E-09	☐
Benzo(k)fluoranthene	207-08-9	6.71E-13	1.20E-08	1.39E-07	☐	7.46E-06		☐
Bis(2-ethylhexyl)phthalate	117-81-7	2.45E-10	4.36E-06	9.76E-06	☐	1.09E-02	1.09E-06	☐
Butyraldehyde	123-72-8	1.58E-09	6.56E-05		☐	7.02E-02	9.51E-07	☐
Carbon Dioxide (CO2)	124-38-9	3.45E-06	1.43E-01		☐	1.53E+02	2.84E-06	☐
Carbon Monoxide (CO)	630-08-0	3.69E-06	1.53E-01	1.53E-05	☐	4.10E+01	1.78E-04	☐
Chloromethane	74-87-3	3.60E-13	6.41E-09	5.99E-09	☐	1.60E-05	7.77E-11	☐
Chrysene	218-01-9	4.23E-13	7.52E-09	8.77E-09	☐	1.88E-05	9.39E-08	☐
Copper	7440-50-8	3.10E-10	1.29E-05	8.81E-08	☐	1.38E-02	4.59E-06	☐
Dibutyl phthalate	84-74-2	1.40E-10	5.81E-06	1.59E-08	☐	6.21E-03	4.14E-07	☐
Ethane	74-84-0	1.51E-09	6.28E-05		☐	1.68E-02		☐
Ethylene	74-85-1	1.79E-08	7.44E-04		☐	7.96E-01	1.73E-06	☐
Fluoranthene	206-44-0	5.55E-13	2.31E-08	1.58E-10	☐	2.47E-05	8.23E-07	☐
Fluorene	86-73-7	2.10E-12	8.72E-08	5.98E-10	☐	9.33E-05	1.24E-09	☐
Formaldehyde	50-00-0	4.01E-09	7.13E-05	5.13E-04	☐	4.45E-02	3.62E-05	☐
Hydrogen Cyanide	74-90-8	3.81E-09	1.58E-04	5.05E-05	☐	1.69E-01	3.27E-05	☐

Long Rifle .22 Caliber Ball Cartridge *Modeled Distance (meters) 100* *DODIC:* A106

Substance*	CAS#	CONC	Cchronic	Cchr/HBSL	Cchr/HBSL>1?	Cacute	Cact/ATV	Cact/ATV>1?
Indeno(1,2,3-cd)pyrene	193-39-5	1.60E-12	2.85E-08	3.32E-06	☐	1.78E-05		☐
Lead	7439-92-1	8.52E-08	3.54E-03	1.77E-03	☐	3.79E+00	2.52E-02	☐
Methane	74-82-8	2.59E-08	1.07E-03		☐	1.15E+00	3.48E-07	☐
Methyl t-Butyl Ether	1634-04-4	1.32E-12	5.47E-08	1.75E-11	☐	5.85E-05	1.35E-10	☐
Methylene Chloride	75-09-2	8.40E-09	1.49E-04	3.94E-05	☐	9.33E-02	1.34E-07	☐
Naphthalene	91-20-3	1.75E-10	7.29E-06	2.33E-06	☐	7.80E-03	9.92E-08	☐
Nitric Acid	7697-37-2	4.07E-09	1.69E-04		☐	4.52E-02	3.48E-05	☐
Nitroglycerine	55-63-0	3.17E-10	5.65E-06	1.26E-05	☐	3.53E-03		☐
OCDD	3268-87-9	1.12E-16	4.65E-12		☐	4.97E-09	3.32E-11	☐
OCDF	39001-02-0	6.33E-17	2.63E-12		☐	2.81E-09	9.37E-12	☐
Oxides of Nitrogen (NOx)	10102-43-9	1.50E-07	6.25E-03	6.25E-05	☐	6.68E+00	2.17E-04	☐
Particulate Matter <10 micron	PM10	1.54E-07	6.40E-03	1.28E-04	☐	1.71E+00		☐
Particulate Matter <2.5 micron	PM2.5	1.18E-07	4.89E-03	3.26E-04	☐	1.31E+00		☐
Pentane	109-66-0	2.76E-12	1.14E-07		☐	1.22E-04	6.81E-11	☐
Phenanthrene	85-01-8	2.51E-12	1.04E-07		☐	1.11E-04	5.57E-08	☐
Propylene	115-07-1	3.22E-09	1.34E-04		☐	3.58E-02		☐
Pyrene	129-00-0	1.06E-12	4.41E-08	4.01E-10	☐	4.72E-05	3.15E-09	☐
Styrene	100-42-5	1.37E-10	5.69E-06	5.45E-09	☐	1.52E-03	7.14E-09	☐
Toluene	108-88-3	2.81E-10	1.17E-05	2.90E-08	☐	3.12E-03	1.66E-08	☐

Long Rifle .22 Caliber Ball Cartridge **Modeled Distance (meters) 100** **DODIC:** A106

*Substance**	*CAS#*	*CONC*	*Cchronic*	*Cchr/HBSL*	*Cchr/HBSL>1?*	*Cacute*	*Cact/ATV*	*Cact/ATV>1?*
Total Suspended Particulate	12789-66-1	1.52E-07	6.30E-03	1.26E-04	☐	1.69E+00		☐
Trichlorofluoromethane	75-69-4	1.70E-12	7.05E-08	9.66E-11	☐	7.55E-05	2.69E-11	☐
Zinc	7440-66-6	7.15E-10	2.97E-05	2.71E-08	☐	3.18E-02	1.06E-06	☐

** = Only substances detected in the Firing Point Emission Study are presented in this Appendix. In situations where the substance was detected using more than one sampling method, the higher concentration was used in the risk assessment to maintain a conservative approach.*
DODIC = Department of Defense Identification Code
CAS# = Chemical Abstract Service Number
CONC = average modeled concentration for one cartridge (g/m³)
Cchronic = chronic time-averaged concentration (µg/m³)
HBSL = chronic health-based screening level (µg/m³)
Cacute = acute time-averaged concentration (µg/m³)
ATV = acute toxicity value (µg/m³)

Table D-2: Comparison of Modeled Air Concentrations with Health-Based Values: Total Petroleum Hydrocarbons

Long Rifle .22 Caliber Ball Cartridge *Modeled Distance (meters)* 100 **DODIC:** A106

*Substance**	*CAS#*	*Cchronic Aliphatic:<=8*	*Cchronic Aliphatic:>8*	*Cchronic Aromatic:<=8*	*Cchronic Aromatic:>8*
1,3-Butadiene	106-99-0	9.93E-06			
Acenaphthene	83-32-9				3.55E-08
Acenaphthylene	208-96-8				7.42E-07
Anthracene	120-12-7				1.83E-08
Benzene	71-43-2			4.91E-05	
Benzo(a)anthracene	56-55-3				6.49E-09
Benzo(a)pyrene	50-32-8				2.59E-08
Benzo(b)fluoranthene	205-99-2				1.45E-08
Benzo(e)pyrene	192-97-2				6.21E-08
Benzo(g,h,i)perylene	191-24-2				2.43E-07
Benzo(k)fluoranthene	207-08-9				1.20E-08
Chrysene	218-01-9				7.52E-09
Fluoranthene	206-44-0				2.31E-08
Fluorene	86-73-7				8.72E-08
Indeno(1,2,3-cd)pyrene	193-39-5				2.85E-08
Naphthalene	91-20-3				7.29E-06
Pentane	109-66-0	1.14E-07			

Long Rifle .22 Caliber Ball Cartridge *Modeled Distance (meters)* *100* **DODIC:** A106

*Substance**	*CAS#*	*Cchronic Aliphatic:<=8*	*Cchronic Aliphatic:>8*	*Cchronic Aromatic:<=8*	*Cchronic Aromatic:>8*
Phenanthrene	85-01-8				1.04E-07
Propylene	115-07-1	1.34E-04			
Pyrene	129-00-0				4.41E-08
Styrene	100-42-5				5.69E-06
Toluene	108-88-3			1.17E-05	
Total (μg/m³)		*1.44E-04*		*6.08E-05*	*1.44E-05*
Derived Health-Based Screening Level (μg/m³)		*1.92E+04*	*1.04E+03*	*4.17E+02*	*2.09E+02*
Cchronic/HBSL		*7.49E-09*		*1.46E-07*	*6.90E-08*
Is this ratio >1?		*No*	*No*	*No*	*No*

** = Only substances detected in the Firing Point Emission Study are presented in this Appendix. In situations where the substance was detected using more than one sampling method, the higher concentration was used in the risk assessment to maintain a conservative approach.*
DODIC = Department of Defence Identification Code
CAS# = Chemical Abstract Service Number
Cchronic = chronic time-averaged concentration (μg/m³)
HBSL = chronic health-based screening level (μg/m³)

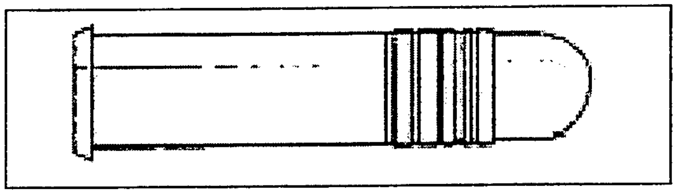
APPENDIX E

FACT SHEET SUBMITTED TO THE U.S. ARMY ENVIRONMENTAL CENTER

U.S. Army Environmental Center
Training Munitions Fact Sheet

Long Rifle .22 Caliber Ball Cartridge
Department of Defense Identification Code: A106

Breathing air emissions from the Long Rifle .22 Caliber Ball Cartridge will not impact the health of residents who live near Army training facilities.



To be fully prepared to protect our country, U.S. soldiers must train with many different weapons and munitions, including the Long Rifle .22 Caliber Ball Cartridge (.22 Caliber Ball). This training is important because it helps prepare our soldiers for a variety of combat situations. While the Army recognizes the value of such comprehensive training on our installations, we also work hard to ensure the safety and health of surrounding communities.

WILL BREATHING AIR EMISSIONS FROM THE LONG RIFLE .22 CALIBER BALL CARTRIDGE AFFECT MY HEALTH?

To answer this question, the U.S. Army tested the air emissions that are released when the .22 Caliber Ball is fired. The information gathered during these tests was then analyzed to determine if there would be a potential for health effects from inhalation to residents who live near training areas. Study results, generated using conservative methods, showed that offsite residents breathing air as close as 100 meters (328 feet or about the length of a football field) from the firing location are safe from these emissions. At most locations, training areas are at least 1,000 meters (over half a mile) away from populated areas and the distance to firing locations may be even farther.

HOW WAS THE STUDY CONDUCTED?

To gather data for this study, the .22 Caliber Ball was fired from a rifle in a test chamber. The air in the chamber was then tested to identify the types and amounts of substances released. About 200 different substances were looked for during this part of the study.

This information was then used in an U.S. Environmental Protection Agency (USEPA) approved air model (a computer program that allows estimation of air concentrations) to determine the amount of each substance to which someone

living near a training site might be exposed. Downwind concentrations were estimated based on a typical use scenario for the .22 Caliber Ball during training exercises. Since this study did not look at any one specific training area, the assumptions used in the model would, in most cases, predict higher downwind air concentrations than those expected at an actual training site.

These estimated air concentrations were then compared to screening levels established by the USEPA and other federal agencies. If the air concentrations are below these screening levels, they are considered safe for the general population, including sensitive people such as the sick, elderly, and children.

WHAT ARE THE STUDY LIMITATIONS?

Many steps were taken to ensure that the results of this study are protective of residents who live near training facilities. However, as with any study, this study has limitations. For example, the study does not consider exposure to other types of munitions that could also be used during the same training event. Due to these limitations, conservative model conditions were used to ensure the protection of public health from breathing .22 Caliber Ball air emissions.

WHAT EXACTLY IS THE LONG RIFLE .22 CALIBER BALL CARTRIDGE?

The .22 Caliber Ball is a type of ball ammunition used for marksmanship practice and match use. The .22 Caliber Ball consists of a copper alloy cartridge case and a lead-antimony bullet. It also contains a propelling charge that consists mostly of nitrocellulose. Nitrocellulose is the primary ingredient in smokeless propellant (for both military and commercial use) and is also used in the production of lacquers and artificial leathers. Each .22 Caliber Ball is about as long as the width of a quarter.

WHERE CAN I GET MORE INFORMATION?

For more information on the .22 Caliber Ball or other military munitions, please call the Army Environmental Hotline at 1-800-USA-3845, visit our Web site at www.aec.army.mil, or e-mail t2hotline@aec.apgea.army.mil.